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THE TELEPHONE IN THEATRICAL MANAGEMENT.

It would appear that the applications of electricity especially in the spectacular effects for illumination in those concentrations of human activities which we term the stage, had been carried to the point of exhaustion, yet the wonderful presentation of Schiller's play of Joan of Arc in the Harvard Stadium has added a new picture to the subject.

The seventeen hundred performers in that great amphitheatre is considered the largest number ever appearing in the rendition of a scenic production, and the vast audience which nearly filled the seats, which have a capacity for twenty-one thousand, was certainly the greatest audience ever witnessing a theatrical production.

In this realistic and succession of scenes of action depicting the career of the Maid of Orleans the distances were so magnificent as to be beyond the usual methods of theatrical management.

Although the actors and groups of supernumeraries were under the instruction of managers, yet there was even more of a necessity for a supreme head than on the usual boards. This was provided by a bower among other scenery in the middle of the amphitheatre, where the stage manager and his immediate associates operated the lighting by means of the switches, by signal bells which gave instructions to others operating the switches in different parts of this great structure, and in addition to the greater uses of electricity there were a number of telephones reaching to those in management of different parts of the play.

As this great spectacle was without precedent, it is probably equally true that it will not be repeated on account of the lack of an amphitheatre sufficient to give provision for the representation of these movements of armies on such an extended scale.

LOAD FACTORS.

One of the most engrossing topics to which the central-station manager has in recent years fortunately had his attention directed is the study of load factors. He has come to realize that by the improvement of the load factor of his plant he can materially increase the returns on the investment, or, in other words, reduce the percentage of the fixed charges. Of equal importance is the matter of load factors of consumers' installations. In order to know what is likely to be a prospective consumer's maximum demand, so that proper provision

be made for his service, and in order to estimate his revenue-producing power, so that an equitable rate be adopted, it is necessary to predetermine his probable load factor. This applies particularly to power consumers. Data on such load factors have hitherto been very scarce, however.

Among the many important papers presented before the recent convention of the National Electric Light Association was one by Mr. E. W. Lloyd, entitled "Compilation of Load Factors." This paper is practically the first to supply reliable data along the lines referred to above. It was undoubtedly one of the most valuable papers submitted to the central-station men at the convention, and is given quite fully on other pages of this issue. While these data are based on industrial conditions in Chicago, and are of the highest value where similar conditions prevail, they are worthy of the closest study by all central-station men, even in communities where conditions are radically different. This interesting collection of data should prove an incentive for the compilation of load factors by every central-station company.

SOME MOTOR LOADS.

A study of the motor loads on the electrical supply systems in a number of cities and towns shows that power service is still rendered with both direct and alternating current at a variety of voltages.

Either water power or steam serves for the operation of a large motor load, and such loads vary greatly in amount per thousand of the population, and in earnings per unit of motor capacity.

Generating stations of large capacity are supposed to show high efficiency and to attract motor loads by low rates, but it appears that some of the lowest annual incomes per horsepower of motors served are found in the small cities and the towns. While large cities with diverse lines of manufactures may appear to offer the best fields for motor loads on electrical supply systems, the fact is that rather small places with only two or three important industries often lead, not only in the horsepower of motors per thousand of population, but in total horsepower as well.

For the purpose of illustrating the facts as to motor loads, all of the electrical supply systems with motor loads of more than 900 horsepower capacity each in an important state have been considered. These electrical systems number seventeen, and serve populations that range from about 11,000 to more than half a million, and operate motor loads that vary from 935 horsepower as the minimum to nearly 40,000 horsepower for the maximum.

Out of the seventeen electrical supply systems, eight operate direct-current generators at 500 to 550 volts for all or parts of their motor loads, and in the other eight systems the same generators furnish current for both motors and incandescent lamps. Three of these latter systems operate direct-current three-wire circuits, and at least a large part of their motor loads are supplied from the two outside wires of these circuits. In at least two large stations the alternating current, generated at about 2,300 volts, is transformed to 550 volts and distributed by separate lines to induction motors at this voltage. An alternator is operated at 2,300 volts, especially for power work in one case.

The largest motor load per thousand of the population was 108 horsepower, in a town of about 13,000 inhabitants, while the smallest motor load per thousand of population was 11.2 horsepower, in a city of more than 100,000 inhabitants.

Per horsepower of connected motors, the least power income during a recent year was $14.04, for an electrical supply system in a city of about 28,000 people; but the system that served more than half a million people got $15.73 per connected horsepower, and the system supplying about 11,000 people got only $16.08 per horsepower.

The highest income per horsepower of connected motors was $30.17, but this rate secured a load of only 12.2 horsepower per thousand inhabitants, in a city with more than 100,000 people.

A town with a rather large number of manufacturing plants of the same sort, each plant using only a few tens of horsepower, furnished the maximum connected load of 108 horsepower in motors per thousand inhabitants, and the income from this load was $21.40 per horsepower during the year. Steam was the only source of power for the station that operated this load, and the current for the motors was generated at 2,300 volts, sixty cycles and three-phase. Circuits for the distribution of power to motors carried no lamps, and the line voltage was transformed to 110 for most of the induction motors.

The town with a total load of 935 horsepower in connected motors, or eighty-three horsepower per thousand population, was supplied with electric energy from both steam and water power, but the water power was from a very variable river, with only slight storage area. Each connected horsepower of motors earned $16.08 for this electric system during the year, and all the current was generated by alternators.

In the city with a connected load of 1,192 horsepower in motors, but only 11.2 horsepower per thousand of the population, the electric income from motors was $25.55 per horsepower. This city of more than 100,000 people is a great center of textile industry, in which large amounts of power are used, but the local electric system has not made the rates necessary to attract this load. While the electric system in this case includes no water power, it is very favorably located for the cheap development of power with steam.

Another city with large textile interests had a connected motor load of 2,154 horsepower, or sixty-five horsepower per thousand inhabitants, this load per thousand being larger than that of any other city in the group. The gross income from this motor load was $22.36 per horsepower during the year, and the electric generating station was operated entirely with steam power.

In this case all of the motors were operated with sixty-cycle, three-phase current, many of them being connected to

550-volt alternating power lines that ran from the generating station, and much of the power load was cotton-mill work.

The electric system having a connected motor load of 6,435 horsepower, the second largest in the state, operated 58.1 horsepower of motors per thousand of the population served, and earned $17.40 gross per motor horsepower. In this case the motor service was partly with direct and partly with alternating current, the former at 500 volts, and a large percentage of the motor load was in textile mills, though the electric generating station was operated entirely with steam power.

With a load of only 1,238 horsepower in capacity of connected motors, or forty-four horsepower per thousand inhabitants, the income rate of $14.04 per horsepower of connected motors was reached, and the electric system that rendered this service had no water power. The power supply in this case was with both direct and alternating current, the former at 550 volts.

One of the electric systems using both water and steam power had a connected motor load of 1,771 horsepower, or 19.7 horsepower per thousand of the population, and this load paid an income of $22.78 per horsepower.

Another system operating in part with water power had 2,576 horsepower of connected motors, that paid $19.30 per horsepower during the year, and this load amounted to 51.6 horsepower per thousand persons in the supply area.

The one other of the seventeen electrical supply systems that used waterpower had 3,799 connected horsepower in motors, or forty-four horsepower per thousand people, that paid $23.06 per horsepower during the year.

In the largest electric supply system of the state, with 39,422 horsepower of connected motors, the earnings per horsepower were $15.73, and there were 56.1 horsepower per thousand of the population. Some of the power service in this case was with 500-volt direct current, but the great bulk of the load was connected to the 250-volt outside conductors of a three-wire system.

THE ANNUAL REPORT OF THE COMMISSIONER OF PATENTS.

The annual report of the Commissioner of Patents to Congress for the year ending December 31, 1908, makes interesting reading. The receipts from all sources amounted to $1,896,847 and the expenditures were $1,712,303, leaving a balance of over $184,000. The balance in the treasury on January 1 amounts to nearly $7,000,000. The total number of applications for patents for inventions, designs and for reissues was 61,475, and of this number there was a total of 33,682 patents issued.

In proportion to the population more patents were issued to citizens of the District of Columbia than to those of any state, one to every 1,115.

The reorganization of the bureau under the system inaugurated by Secretary Garfield has resulted in vastly improving the conditions heretofore existing. The bureau has been given twenty-three additional rooms, the force has been augmented and the salaries increased. The new conditions created by Congress and the Secretary of the Interior have made it possible to bring up the work of the Patent Office so that it is now current except in five of the examining divisions out of the forty-one.

In his report Commissioner of Patents Moore invites the attention of Congress to the necessity for legislation which would result in the establishment of a patent bar. It is suggested that a law be enacted providing that before an individual be permitted to practice before the United States Patent Office he shall be required to first pass an examination as to his moral, legal and technical qualifications; that a committee shall be appointed by the Commissioner of Patents composed of Patent Office officials and patent attorneys of well-known standing in the profession, who shall conduct the examination under the direction of the Commissioner of Patents, and the report of said committee shall be subject to his approval.

This report is decidedly refreshing and should be a cause of sincere congratulation on the part of those who were instrumental in bringing about the movements referred to by the Commissioner of Patents. There is still a very large surplus in the Patent Office treasury, and this will make it possible to make still further improvements.

It is unfortunate that the fine record announced in this report must be coupled with an explanation that this week it has been impossible to publish a list of electrical patents issued on Tuesday, July 6, owing to the failure of the delivery of the Official Gazette of the United States Patent Office up to the time of going to press.

COURT UPHOLDS READINESS TO SERVE CHARGE.

The Supreme Court of Arkansas on June 14 last rendered a decision in favor of the Little Rock Railway and Electric Light Company establishing the right of the company to stipulate a "readiness to serve" charge in making a contract with a new customer. The plaintiff in the original suit contended that the act of the General Assembly of 1905 did not provide for a readiness to serve charge or a minimum rate charge, as the act specifically fixes upon the company the furnishing of meters to customers without charge, the supplying of printed tables showing the price charged for current, and basing the charge for the commodity upon the reading of these meters.

The court holds that the manifest design of the act was to provide means whereby the consumer may be informed as to the exact charge for service and to require a uniformity of charges against all customers using like quantities of the commodity. Nowhere does the statute attempt to say that persons using different quantities of the commodity in a given time must be charged the same price per unit, nor that a minimum charge per month for service may not be imposed. The Legislature did not intend to compel the company to put in a meter and hold itself in readiness to serve those who use none of the commodity to be supplied, and the language of the act does not warrant the construction that the fixing of a minimum charge was to be forbidden.

New York State Public Service Commission.

The Public Service Commission completed the second year of its existence on July 1, and Chairman William R. Willcox, of the Commission for the First District, makes the following statement as to the work of the Commission since its creation:

"Inasmuch as the greatest problems before the Commission lie in the field of transportation, the bulk of our work has been directed largely to paving the way for new rapid-transit facilities and increasing and improving the service on existing lines. In both directions, I think, the Commission has made substantial progress. The Commission has encouraged the entrance of competitors into the traction field and has framed a law, which was passed by the Legislature, amending the Rapid Transit Act, so that the city now has three ways of building rapid-transit lines, against one method allowed by the old law. It has also proposed and advocated the passage of a constitutional amendment, which will be submitted to the people next fall, providing that bonds used for the construction of self-supporting rapid-transit lines will not be included in computing the debt limit, thus adding about $100,000,000 to the city's borrowing capacity.

"In speaking of the new law, I refer to the Travis-Robinson bill amending the Rapid Transit Act, which was passed by the last Legislature, signed by the Governor, and is now on the statute books. Under the terms of this law it is now possible for New York city, in addition to building subways with its own money, to defray the cost of rapid-transit lines either by assessment upon the property benefited or by the enlistment of private capital. This law has already been productive of offers from private interests to build new subways, and there seems to be no question that when the Commission advertises the new routes there will be no lack of bidders.

"During the last two years the Commission has planned a new system of subways to connect the boroughs of Manhattan, the Bronx and Brooklyn, and as soon as the detailed plans and forms of contracts can be prepared—a work that will be pushed immediately—will advertise for bids for its construction. This system embraces the Broadway-Lexington Avenue route as laid down by the Commission, extending from the Battery to and through the borough of the Bronx; the Fourth Avenue subway, extending from the Brooklyn terminal of the Manhattan Bridge through Flatbush Avenue extension and Fourth Avenue, Brooklyn, to Forty-third Street, with branches to Fort Hamilton and Coney Island; the Canal Street subway, extending across Manhattan from the Hudson to near the East River, and the Broadway-Lafayette subway in Brooklyn, leading from the Brooklyn terminal of the Williamsburg Bridge out Broadway and back through Lafayette Avenue to a junction with the Fourth Avenue subway. The Commission has also prosecuted work on the Brooklyn loop subway, which is to connect the Manhattan terminals of the Brooklyn, Manhattan and Williamsburg bridges, and which, when completed, will form an important part of the new system.

"It has been the fortune of the Commission to witness the relief of the Brooklyn Bridge crush by the extension of the city subway to Brooklyn, and by the practical elimination of delays caused by trolley cars. The accomplishment of the latter has been due to the orders issued by the Commission for the overhauling and repair of trolley cars, and since these orders have been enforced, the blockades on the trolley tracks over the bridge have almost entirely disappeared.

"The Commission's orders for overhauling and repair of the surface cars also have resulted in great improvement in the surface. Millions of dollars have been spent by the companies in overhauling their equipment and providing new cars, and the result is apparent in the decreased delays due to breakdown. The spectacle of long lines of surface cars, blocked by reason of the breakdown of the car at the head of the line, is now very rare.

"The present subway has claimed a great deal of attention from the Commission. Its service has been improved in many ways, and the Commission has recently ordered the equipment of all cars used in the express service with side doors. The Commission has also provided for the lengthening of the station platforms in the subway, so that they will be able to accommodate ten-car express trains and six-car local trains, the present platforms being limited to eight-car express trains and five-car local trains. The speed-control system, recommended by the Commission's consulting engineer, Bion J. Arnold, has been tried with good effect, and the Interborough company plans to extend it until the entire express service will be covered. When all of these improvements have been made, the service will be greatly bettered and it will be possible to use the subway to the limit of its capacity.

"In regard to surface-railroad transportation, the Commission has brought about improvement in service in all parts of the city. While it is impossible, with present facilities, to provide every passenger a seat during the rush hours, the companies have responded to the efforts of the Commission to obtain better service with excellent results.

"In a thorough investigation, the Commission opposed the methods by which the Metropolitan Street Railway system was wrecked, and brought to light many other things, the 'paper railroad' deal, by which a local company was forced to pay $965,000 for a franchise for which the owner asked only $250,000, the final result of the exposure being the restitution by the recipients of the money paid over and above the purchase price. The repetition of such methods, I believe, has been carefully guarded against by the precautions which the Commission has taken to insure the keeping of uniform system of accounts by the railroad and street-railroad companies subject to constant supervision by the Commission."

UP-STATE COMMISSION'S REPORT.

The Public Service Commission for the Second District had upon the close of business, June 30, handled 2,990 cases; 2,003 of these were treated informally and 1,721 of them disposed of and closed on the records during the two years' existence of the Commission. In this period 987 cases were made formal and orders served in each case; 859 hearings were given, at which formal cases were heard.

The number of applications received for capitalization was 145, and the total amount authorized $155,708,925.49. Of this amount $111,200,500 were bonds, $19,454,600 capital stock, and the remainder various kinds of evidences of indebtedness.

The building of nine new railroads and street railroads has been authorized and permission to extend lines has been granted in fifteen cases.

The elimination in grade of twenty-five crossings has been ordered. Work in this direction can proceed no further because the Legislature has made no appropriation this year for continuing this work.

Thirty-seven gas and electric corporations and two municipalities have been authorized to exercise franchises and fifteen companies have been given permission to assign, transfer or lease their properties to new corporations.

DISTORTED WAVES AND THEIR ANALYSIS BY A SIMPLE METHOD.

BY HENRY HERMANN.

I. Introduction.

It is a well-known fact, that pressure waves obtained from synchronous machines, especially under load, deviate more or less from the true sine form; that is, instantaneous values of the induced electromotive-force do not follow a simple sine law. Similarly, if a sine wave of electromotive-force is impressed upon a circuit containing iron, the cyclic variation of the magnetic reluctance brings about a distortion of the current wave. As a rule, self-induction in the electric circuit reduces, capacity augments the higher harmonics initially present in a distorted pressure wave. While in some cases this distortion of wave shape is of little importance, and the deviations from the true sine form may be neglected, there are instances where it becomes desirable or even necessary to resolve the distorted wave into its harmonic components. Considering complex waves from the standpoint of the mathematician or physicist, that is, treating the curve as a series of sine functions the members of which are unknown, the analysis of such waves is at the best a time-consuming process.

Dealing with the problem of distorted waves in engineering practice, the electrical profession, which up to a comparatively short time ago has practically ignored the irregularities originated by the presence of higher harmonics, has come to recognize that frequently it is not permissible to replace the distorted wave by its equivalent sine wave, that is, the true sine wave of equal intensity and power as the distorted wave.

In all those cases, then, where it becomes necessary to consider the fictitious[1] components of the complex wave individually, experience has shown it to be sufficient to determine the amplitude of the fundamental wave and a few terms of higher order.

Apart from the case of very complex waves (and even here it is possible to tell beforehand what principal harmonics are present), it is not difficult to determine the equation of a distorted wave from the oscillogram exact enough for most practical purposes. Moreover, in almost every instance where the distortion of wave shape must be taken into account we are dealing with a typical distorted wave, the constituents of which are known to the engineer engaged in alternating-current work. Such waves may be conveniently analyzed by the method outlined below. In the latter part of the paper several tables will be found, showing a number of typical waves, together with the formulas, expressing the amplitudes of the harmonic components in terms of certain ordinates.

[1] It hardly needs mentioning, that the fundamental wave as well as the higher harmonics are merely mathematical fictions. They have no independent physical existence.

II. Principal Features of Distorted Waves.

Before occupying ourselves with the subject of wave-form analysis, let us briefly consider the principal features of distorted pressure and current waves.

(a) **Symmetrical and unsymmetrical waves.**—No-load pressure waves obtained from synchronous machines obviously are symmetrical with respect to both axes. For brevity we will call them "symmetrical waves."

Pressure waves with the machine delivering power, as well as current waves,

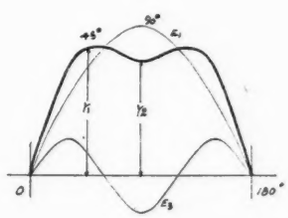


FIG. A.

quite often are no longer symmetrical with respect to both axes. By reason of symmetry, however, both half waves must be alike, that is, one must be the exact image of the other. Waves of this type, which are characterized by the presence of a time-phase displacement between the complex wave and its harmonic components, we will call "unsymmetrical waves." It is the symmetry just referred to, that only harmonics of odd order enter the equation of a distorted wave.[1]

(b) **Principal higher harmonic, and its effect upon the general appearance of the distorted wave.**—The general appearance of distorted waves is determined by the principal higher harmonic, which is either of triple or quintuple frequency.

[1] Evidently the distribution of the field in the air gap, under a north pole, must be the same as that under a corresponding south pole. This implies that in the wave of induced electromotive-force ordinates lying 180 degrees apart have the same numerical value, their signs, however, being reversed. The question whether only odd harmonics with a time-phase displacement are present in unsymmetrical waves has not been settled beyond doubt. Recent experiments seem to indicate that the magnetic oscillations due to the armature teeth in synchronous machines superimpose higher harmonics of even order, which, however, reverse their sign every half cycle. The discussion of this point is beyond the scope of the present paper.

(a) *Effect of a pronounced third harmonic.*—As seen from Figs. 1 and 2, Table I, a pronounced harmonic of triple frequency affects the appearance of the wave as follows: If the third harmonic is positive, that is, if counting the time from the zero point of the complex curve, E_3 rises positively (in the same sense as E_1), the complex wave will be flat topped. (Fig. 1, Table I, and Fig. A.) If, however, E_3 is negative, that is, if, after crossing the base line, it rises in opposition to E_1, its effect will be to produce a distorted wave of the peaked type. (Fig. 2, Table I.) This holds true, both in the case of symmetrical and unsymmetrical waves.

(β) *Effect of prominent fifth harmonic.*—Contrary to what has been said regarding a prominent third harmonic, a strong harmonic component of quintuple frequency gives rise to a peaked (saw-toothed) wave, if E_5 is positive. If the fifth harmonic rises in opposition to the fundamental, a flat-topped wave is the result. (Figs. 3 and 4, Table I.)

(c) **Minor higher harmonics.**—Besides the principal higher harmonic, that is, either the third or the fifth, sometimes there are present to an appreciable extent harmonic components of higher order than the principal member. For example, a wave with a prominent triple harmonic may contain a fifth, a seventh or a ninth harmonic, or probably several of them, a similar reasoning applying to waves with a principal fifth harmonic. The order of the highest harmonic present to an appreciable extent may be arrived at from the number of singularities contained in the distorted wave. Referring to Fig. 5, Table II, which represents a wave of the equation $y = E_1 \sin \omega t + E_3 \sin 3\omega t + E_9 \sin 9\omega t$, the presence of a noticeable ninth harmonic is indicated by the nine singularities, marked 1 to 9. When coming to the discussion of the tables below, more details pertaining to the characteristic features of the distorted waves will be given.

III. Analysis of Typical Waves.

A.—Method Applied to Symmetrical Waves.

The method consists in measuring as many ordinates as the complex wave contains harmonic components, the amplitude of the latter being determined by a simple mathematical process.

(a) **Waves containing a fundamental and one higher harmonic.**—Let us apply

the principle indicated to a wave, as shown in Fig. A, which has the equation,

$$y = E_1 \sin \omega t + E_3 \sin 3\omega t$$

where ωt is a time angle having its value indicated. To determine E_1 and E_3, the amplitudes of the fundamental wave and of the third harmonic, respectively, erect and measure the ordinates y_1 at 45° and y_2 at 90°. Obviously, the instantaneous values of the distorted wave, as measured by the ordinates y_1 and y_2, respectively, are:

$$y_1 = E_1 \sin 45° + E_3 \sin 3 \times 45° = \frac{1}{\sqrt{2}} (E_1 + E_3)^1$$

or $y_1\sqrt{2} = E_1 + E_3$;

$$y_2 = E_1 \sin 90° + E_3 \sin 3 \times 90° = E_1 - E_3.$$

From these two equations there result,

(a) . . . . $y_1\sqrt{2} + y_2 = 2E_1$

$$E_1 = .71y_1 + .50y_2$$

(b) . . . . $y_1\sqrt{2} - y_2 = 2E_3$

$$E_3 = .71y_1 - .50y_2.$$

In the same manner the amplitudes of the harmonic components of the other waves shown in Table I have been obtained.

(b) **Waves with a fundamental and two higher harmonics.**—The determination of E_1, E_3, and E_5 of a wave as shown in Fig. B, with the equation,

$$y = E_1 \sin \omega t + E_3 \sin 3\omega t + E_5 \sin 5\omega t$$

requires three ordinates to be measured, namely, y_1 at 30°, y_2 at 45°, y_3 at 90°. Substituting for angle ωt in turn the values 30°, 45°, and 90°, into the equation of the wave, we obtain:

$$y_1 = E_1 \sin 30° + E_3 \sin 90° + E_5 \sin 150° = \frac{E_1}{2} + E_3 + \frac{E_5}{2}$$

$$y_2 = E_1 \sin 45° + E_3 \sin 135° + E_5 \sin 225° = \frac{1}{\sqrt{2}} (E_1 + E_3 - E_5)$$

$$\text{or } y_2\sqrt{2} = E_1 + E_3 - E_5$$

$$y_3 = E_1 \sin 90° + E_3 \sin 270° + E_5 \sin 450° = E_1 - E_3 + E_5$$

Solving successively for E_1, E_3, and E_5, we finally obtain:

$$E_1 = .71y_2 + .50y_3$$
$$E_3 = .67y_1 - .33y_3$$
$$E_5 = .67y_1 - .71y_2 + .17y_3$$

Table II shows the most important symmetrical waves, with two higher harmonics, the amplitudes of the latter being determined in the same manner as indicated in the preceding.

(c) **Waves containing a fundamental and three higher harmonics.**—As an instance, we select a wave, as shown in Fig. C, the equation of which is

$$y = E_1 \sin \omega t + E_3 \sin 3\omega t + E_5 \sin 5\omega t + E_7 \sin 7\omega t$$

The number of the harmonic components being four, we require four ordinates, namely: y_1 at 30°, y_2 at 45°, y_3 at 60°,

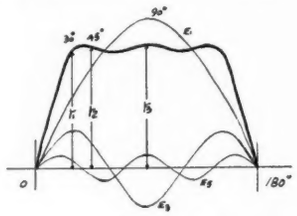


FIG. B.

y_4 at 90°. Assigning to ωt in turn the values 30°, 45°, 60°, and 90°, and proceeding, as explained above, we find

$$y_1 = \frac{E_1}{2} + E_3 + \frac{E_5}{2} - \frac{E_7}{2}$$

$$y_2\sqrt{2} = E_1 + E_3 - E_5 - E_7$$

$$\frac{2y_3}{\sqrt{3}} = E_1 - E_5 + E_7$$

$$y_4 = E_1 - E_3 + E_5 - E_7.^1$$

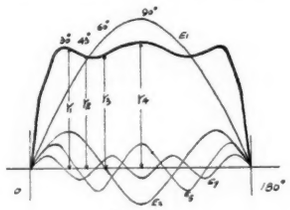


FIG. C.

Solving in turn for E_1, E_3, E_5, and E_7, respectively, we obtain

(a) . . . . $y_1 + y_4 = \frac{3}{2} (E_1 + E_5 - E_7)$

$$\text{or } E_1 + E_5 - E_7 = \frac{2}{3} (y_1 + y_4)$$

$$E_1 - E_5 + E_7 = \frac{2y_3}{\sqrt{3}}$$

$$\text{hence } E_1 = \tfrac{1}{3} (y_1 + y_4) + \frac{y_3}{\sqrt{3}}$$

(b) . . . . $2y_1 = E_1 + 2E_3 + E_5 - E_7 - y_4$

$$= -E_1 + E_3 - E_5 + E_7$$

$$\text{or } 3E_3 = 2y_1 - y_4 \text{ and } E_3 = \tfrac{2}{3}y_1 - \frac{y_4}{3}$$

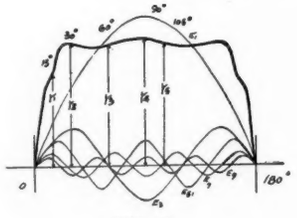


FIG. D.

Similarly we obtain for E_5 and E_7, respectively,

$$E_5 = \tfrac{2}{3}y_1 - \frac{y_2}{\sqrt{2}} + \tfrac{1}{6}y_4$$

$$E_7 = \tfrac{1}{3}y_1 + \frac{y_3}{\sqrt{3}} - \frac{y_2}{\sqrt{2}} - \tfrac{1}{6}y_4$$

As a final result, we may note:

$$E_1 = .33 (y_1 + y_4) + .58y_3$$
$$E_3 = .67y_1 - .33y_4$$
$$E_5 = .67y_1 - .71y_2 + .17y_4$$
$$E_7 = .33y_1 + .58y_3 - .71y_2 - .17y_4$$

In Table III, there are shown a number of typical symmetrical waves containing a fundamental and three higher harmonics.

(d) **Waves with a fundamental and four higher harmonics.**—It is in the nature of things, that if certain harmonics are predominating, others will be suppressed. Taken as a whole, then, it appears to be logical to conclude that in all cases where the distortion of wave shape is considerable, hardly more than two, or at the utmost three, members of higher order will be present. In fact, the more a distorted wave approaches an extreme form, the smaller will be the number of harmonic components which constitute the complex wave. The only exception from

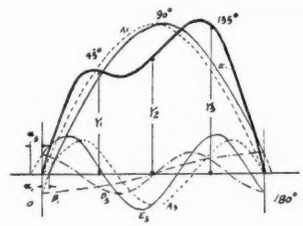


FIG. E.

this rule is probably a curve closely approaching rectangular shape. Here all odd harmonics, up to the ninth, may be present to a appreciable extent. Such a wave has been plotted in Fig. D, the equation of the wave being,

$$y = E_1 \sin \omega t + E_3 \sin 3\omega t + E_5 \sin 5\omega t + E_7 \sin 7\omega t + E_9 \sin 9\omega t$$

Analyzing the curve by our method, we determine the instantaneous values corresponding to the ordinates, y_1, y_2, y_3, y_4, y_5, as shown in Fig. D. Substituting the values $\omega t = 15°, \ldots\ldots, 105°$, successively into the equation of the wave, and solving for the amplitudes of the individual sine waves, we arrive at the following result:

$$E_1 = .33 (y_2 + y_4) + .58y_3$$
$$E_3 = .50y_2 - .55y_6 + .15y_1 + .29y_4$$
$$E_5 = .40 (y_1 + y_6) - .58y_3$$
$$E_7 = .40 (y_1 + y_6) - .33 (y_2 + y_5)$$
$$E_9 = .33y_5 - .17y_2 + .29y_4 - .55y_6 + .15y_1$$

B.—UNSYMMETRICAL WAVES.

Turning our attention to unsymmetrical waves, we shall apply our method to waves with one, two, and three higher harmonics.

(a) **Waves with a fundamental and one higher harmonic.**—A typical example of

[1] $\sin 135° = \sin 45° = \frac{1}{1\sqrt{2}} = 0.707$

[1] Compare these equations with the diagram Fig. C.

a wave of this type is shown in Fig. E, the curve being expressed mathematically, by the equation,

$$y = E_1 \sin(\omega t - a_1) + E_3 \sin 3(\omega t + a_3)$$

As a first step we resolve the sine waves of fundamental and triple frequency into two components each, one, A_1 and A_3, respectively, in time phase with the distorted wave referred to the zero point, and one, B_1 and B_3, respectively, in quadrature therewith.[1] The last equation may then be written

$$y = E_1 \sin \omega t + A_3 \sin 3\omega t - B_1 \cos \omega t + B_3 \cos 3\omega t.$$

For the purpose of analyzing the wave, erect and measure the three ordinates at 45°, at 90°, and at 135°. Proceeding, as shown repeatedly in the above, we obtain for the instantaneous values corresponding to these ordinates:

$$y_1 = A_1 \sin 45° + A_3 \sin 135° - B_1 \cos 45° + B_3 \cos 135°$$

or $y_1\sqrt{2} = A_1 + A_3 - B_1 - B_3$

$$y_2 = A_1 \sin 90° + A_3 \sin 270° - B_1 \cos 90° + B_3 \cos 270° = A_1 - A_3$$

$$y_3 = A_1 \sin 135° + A_3 \sin 405° - B_1 \cos 135° + B_3 \cos 405°$$

or $y_3\sqrt{2} = A_1 + A_3 + B_1 + B_3$

Eliminating the individual members from these equations, we arrive at the formulas:

$$A_1 = .354(y_1 + y_3) + .50y_2$$
$$A_3 = .354(y_1 + y_3) - .50y_2$$
$$B_1 = .354(y_3 - y_1) = B_3$$

It needs no further explanation to show that $B_1 = B_3$ (since $B_1 - B_3 = 0$).

In Table IV, eight typical waves of this type, including the formulas for the amplitudes of the harmonic components, have been reproduced.

(b) Waves with a fundamental and two higher harmonics.—Choosing, as an instance, a wave with a principal third, and a minor fifth harmonic, Fig. F, and proceeding as before, the equation of the wave

$$y = E_1 \sin(\omega t - a_1) + E_3 \sin 3(\omega t + a_3) + E_5 \sin 5(\omega t - a_5)$$

may be written thus:

$$y = A_1 \sin \omega t + A_3 \sin 3\omega t + A_5 \sin 5\omega t - B_1 \cos \omega t + B_3 \cos 3\omega t - B_5 \cos 5\omega t$$

On determining the instantaneous values corresponding to the ordinates y_1, y_2, y_3, y_4, y_5 indicated in Fig. F, and after finally solving the equations, we obtain

$$A_1 = .354(y_2 + y_4) + .50y_3$$
$$A_3 = .33(y_1 + y_5 - y_3)$$
$$A_5 = .33(y_1 + y_5) - .354(y_2 + y_4) + .17y_3$$
$$B_1 = .354(y_4 - y_2)$$
$$B_3 = .58(y_1 - y_5) + .71(y_4 - y_2)$$
$$B_5 = .58(y_1 - y_5) + .354(y_2 + y_4)$$

See also Table V.

(c) Waves with a fundamental and three higher harmonics.—In the preceding we have shown how the amplitudes of the individual sine waves may be found by determining certain instantaneous values. As a final example, we propose the analysis of an unsymmetrical wave with

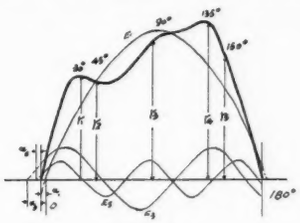


FIG. F.

three higher harmonics, as shown in Fig. G. The equation of this wave

$$y = E_1 \sin(\omega t - a_1) + E_3 \sin 3(\omega t + a_3) + E_5 \sin 5(\omega t + a_5) + E_7 \sin 7(\omega t - a_7)$$

may be written thus

$$y = A_1 \sin \omega t + A_3 \sin 3\omega t + A_5 \sin 5\omega t + A_7 \sin 7\omega t - B_1 \cos \omega t + B_3 \cos 3\omega t + B_5 \cos 5\omega t - B_7 \cos 7\omega t$$

Substituting into this equation in turn the values $\omega t = 30°, \ldots\ldots 150°$, and obtaining the instantaneous values corresponding to the ordinates y_1, y_2, y_3, y_4, y_5, y_6, y_7, inclusive, we arrive at the final result

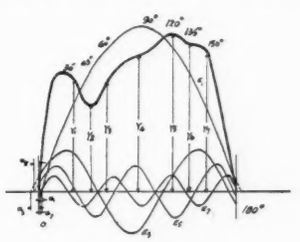


FIG. G.

$$A_1 = .17(y_1 + y_7) + .29(y_3 + y_5) + .33y_4$$
$$A_3 = .33(y_1 + y_7 - y_4)$$
$$A_5 = .33(y_1 + y_7) - .354(y_2 + y_6) + .17y_4$$
$$A_7 = .17(y_1 - y_4 + y_7) - .354(y_2 + y_6) + .29(y_3 + y_5)$$
$$B_1 = .29(y_7 - y_1) + .17(y_5 - y_3)$$
$$B_3 = .33(y_5 - y_3)$$
$$B_5 = .354(y_6 - y_2)$$
$$B_7 = .354(y_6 - y_2) - .29(y_7 - y_1) - .17(y_5 - y_3).$$

Let us verify these results. The curve Fig. G has been plotted to scale after choosing the following values for the amplitudes of the individual harmonics.

$E_1 = 50$ mm.; $E_3 = 12.5$ mm.; $E_5 = 7.5$ mm.; $E_7 = 4.5$ mm. Scaling off the ordinates, $y_1, y_2 \ldots\ldots y_7$, we find them to measure

$y_1 = 33$ mm.; $y_2 = 25.5$ mm.; $y_3 = 33.5$ mm.; $y_4 = 41.5$ mm.; $y_5 = 47$ mm.; $y_6 = 44.5$ mm.; $y_7 = 43$ mm. If our formulas developed above are correct, the substitution of the actual values of the ordinates as taken from the diagram into the equations must obviously give us the amplitudes as arbitrarily assumed when plotting the curve. We have

$A_1 = .17(76) + .29(79.5) + .33(41.5) = 49.7$ mm.

$B_1 = .29(10) + .17(13.5) = 5.2$ mm.

Hence, $E_1 = \sqrt{A_1^2 + B_1^2} = \sqrt{49.7^2 + 5.2^2} = \sqrt{2497} = \pm 50$ mm.

$A_3 = .33(34.5) = 11.4$;

$B_3 = .33(13.5) = 4.5$

Hence, $E_3 = \sqrt{11.4^2 + 4.5^2} = \pm 12.5$ mm.

$A_5 = .33(76) - .354(70) + .17(41.5) = 7.3$;

$B_5 = .354(18.5) - .33(14.5) = 1.9$.

Therefore, $E_5 = \sqrt{7.3^2 + 1.9^2} = \pm 7.5$ mm.

$A_7 = .17(34.5) - .354(70) + .29(79.5) = 4.1$;

$B_7 = .354(19) - .29(10) - .17(14.5) = 1.25$

Hence, $E_7 = \sqrt{4.2^2 + 1.25^2} = \pm 4.5$ mm.

Table VI contains a few more examples of unsymmetrical waves with three higher harmonics.

IV. Tables Showing Typical Waves and Their Analysis.

A.—Symmetrical Waves.

(a) Table I. Symmetrical waves with one higher harmonic.—We have already discussed (under II, **b**, a, and β) the general effect produced by the superposition of a triple or a quintuple harmonic upon a simple sine wave. In addition to these remarks, we gather from Table I, that a

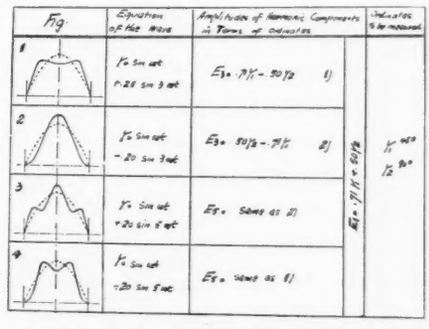


TABLE I.—SYMMETRICAL WAVES WITH ONE HIGHER HARMONIC.

negative third or fifth harmonic tends toward a flat zero, while if E_3 or E_5 is positive, a sharp zero is the result.[1] Re-

[1] In the diagram Fig. E, the full-drawn lines marked E_1 E_3, respectively, represent the fundamental and the third harmonic. By the dotted lines we indicate the sine members, A_1 and A_3, while the dotted curves are to represent the cosine members, B_1 and B_3, referred to above. Here, as well as in the other examples dealt with, the fictitious components of the complex waves have been plotted with the object in view of aiding the reader in understanding the mathematical part of the paper.

[1] The dotted curve in the diagrams represents the fundamental wave. The equation

$$y = \sin \omega t + .25 \sin 3\omega t$$

thus indicates that a sine wave of triple frequency, the amplitude of which is about one-fourth of that of the fundamental wave, has been superimposed upon the latter.

garding the formulas expressing the amplitudes of both sine waves in terms of the ordinates y_1 and y_2 erected at the points 45° and 90°, respectively, it is interesting to note: First, the formula for E_1 is the same in all four cases; second, a positive third and a negative fifth harmonic are determined by the same formula. Analogously, an identical formula applies to $-E_3$, and $+E_5$. As seen, formulas 2 and 3 contain the same members with signs reversed, hence the absolute value of E_3 in either case is the same. Thus we conclude: The analysis of any distorted wave consisting of fundamental and one higher harmonic, may be accomplished by measuring the ordinates y^{45} and

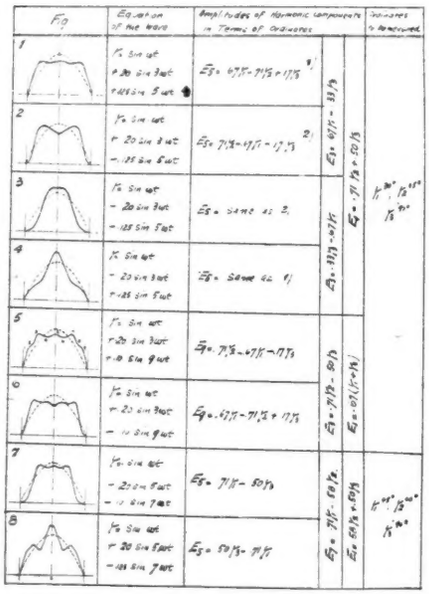


TABLE II.—SYMMETRICAL WAVES WITH TWO HIGHER HARMONICS.

y^{90}. The amplitudes are then found by the formulas:

$E_1 = .71y^{45} + .50y^{90}$.

$E_3 = E_5 = .71y^{45} - .50y^{90}$.

(b) Table II. Symmetrical waves with two higher harmonics.—Discussing the contents of Table II, we observe the following features regarding the effect produced by the individual higher harmonics, as well as the formulas in the third column of the table.

(α) *Waves with a third and fifth harmonic.*—If E_3 and E_5 are both positive (Fig. 1), there is a tendency to produce a flat-topped wave with a sharp zero, the wave approaching more the rectangular shape. (Compare Figs. 1 in Tables I and II.) If E_3 is positive and E_5 negative (Fig. 2), there is a tendency toward a flat zero (but less so than in the case of Fig. 4, Table I). In waves of the peaked type, that is, curves with a principal third harmonic of negative sign, a negative fifth harmonic (Fig. 3) tends toward a very flat zero and a flattened peak, while if E_5 is positive (Fig. 4), a rather sharp zero and a pointed peak will result. As to the amplitudes of the harmonic components, their numerical values are given, irrespective of the phase relation between the individual sine waves, by the formulas:

$E_1 = .71y^{45} + .50y^{90}$

$E_3 = .67y^{30} - .33y^{90}$

$E_5 = .67y^{30} - .71y^{45} + .17y^{90}$.

(β) *Waves with a third and ninth harmonic.*—The appearance of a flat-topped wave is affected by a minor, but appreciable, ninth harmonic, as follows: If E_9 is positive (Fig. 5), a sharp zero will be produced, while the singularity at the middle of the top is directed upward. With E_9 negative (Fig. 6), there is a tendency toward a flatter zero, the inflection at the middle of the top being directed downward. As for the rest, the diagrams are self-explanatory. Here, too, the numerical values of E_1, E_3, and E_9, respectively, are obtained from the formulas

$E_1 = .67\ (y^{30} + y^{90})$

$E_3 = .71y^{45} - .50y^{90}$

$E_5 = .67y^{30} - .71y^{45} + .17y^{90}$.

(γ) *Waves with a fifth and a seventh harmonic.*—A negative seventh harmonic in a wave with a principal negative fifth harmonic tends toward a very flat zero, and a rather smooth top (Fig. 7). If the fifth harmonic is positive while E_7 is negative, a pointed peak will result, while in the middle part the wave becomes more broadened. (Compare Figs. 7 and 8, Table II, with Figs. 3 and 4, Table I.) As to amplitudes of the harmonics, their numerical values are found by application of the formulas already given. Concluding our discussion of Table II, we believe that the development of the formulas, in particular those referring to Figs. 1 to 4, inclusive, will prove of some practical value.

(c) Symmetrical waves with three higher harmonics.—Table III contains, as will be seen, six waves with a principal third harmonic, Figs. 1 to 6, and two waves with a principal fifth harmonic, Figs. 7 and 8. All information pertaining to the characteristic features of these curves, may be obtained from a comparison with the corresponding waves in Table II. Regarding the formulas expressing the amplitudes of the harmonic components in terms of the ordinates, we observe: First, the amplitude E_1 of the fundamental wave is given, irrespective of the equation of the wave, by the formula

$E_1 = .33(y^{30} + y^{90}) + .58y^{60}$

Second, comparing the formulas for E_3 and E_5, pertaining to waves with a principal third harmonic, we note that if the order of the highest harmonic is less than nine (Figs. 1 to 4), the numerical values of E_3 and E_5 are determined by the formulas:

$E_3 = .67y^{30} - .33y^{90}$

$E_5 = .67y^{30} - .71y^{45} + .17y^{90}$

The presence of an appreciable ninth harmonic (Figs. 5 and 6) changes the formulas to:

$E_3 = .58y^{60} - .71y^{45} + .33y^{30} + .17y^{90}$

$E_5 = .33y\ (y^{30} + y^{90}) - .58y^{60}$.

Turning to Figs. 7 and 8, which show two waves with a principal fifth harmonic,

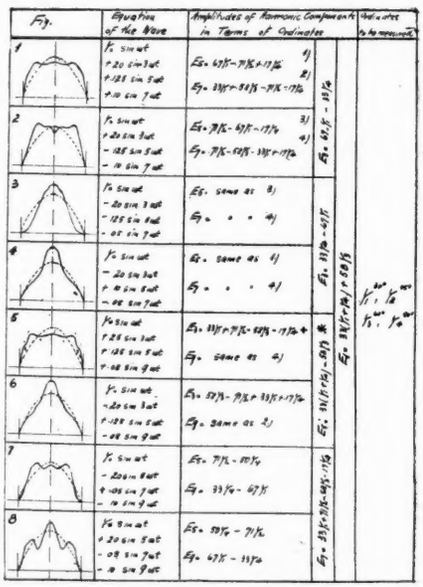


TABLE III.—SYMMETRICAL WAVES WITH THREE HIGHER HARMONICS.

we are interested in first determining the amplitude E_5. The latter is found either by the formula

$E_5 = .71y^{45} - .50y^{90}$

or the formula marked * may be applied. It is not very likely that waves of the type as shown in Figs. 7 and 8 are frequently encountered in practice which contain a ninth harmonic of such magnitude that it must be taken into account in our calculation. In general, then, if the wave recorded does not contain nine distinct singularities, formulas 1 and 2 (Fig. 1) may be applied to determine E_5 and E_7 in waves with a principal fifth harmonic. In the last chapter of this paper the results obtained so far will be reviewed in a condensed form.

B.—UNSYMMETRICAL WAVES.

(a) Table IV. Unsymmetrical waves with one higher harmonic.—This table

shows eight typical waves familiar to the eye of the electrical engineer. The characteristic features of the waves will be readily understood by comparing them with the curves represented in Table I. From Table IV the location of the maximum ordinate is determined by the phase relation between the complex wave and that of fundamental frequency. In the case of waves consisting of a fundamental and a superimposed third harmonic, a leading E_1 displaces $y_{max.}$ toward the left from the middle ordinate (Figs. 2 and 3), while if E_1 is lagging (Figs. 1 and 4), a maximum instantaneous value is found to the right from y^{90}. If the curve consists of a fundamental and a wave of quintuple

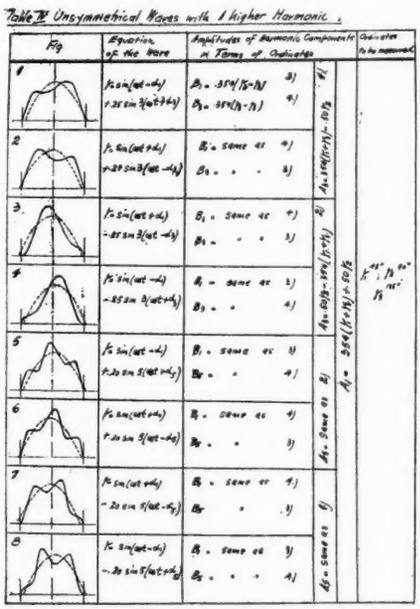


TABLE IV.—UNSYMMETRICAL WAVES WITH ONE HIGHER HARMONIC.

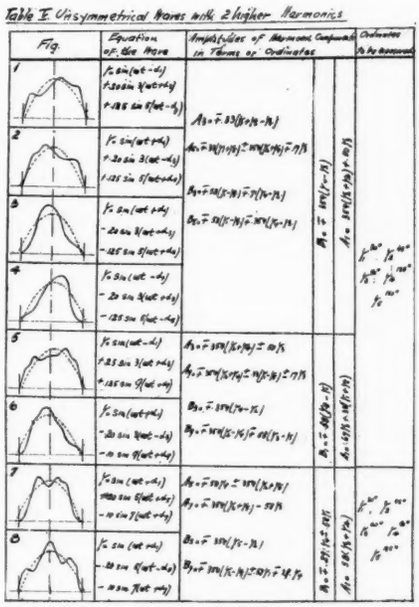


TABLE V.—UNSYMMETRICAL WAVES WITH TWO HIGHER HARMONICS.

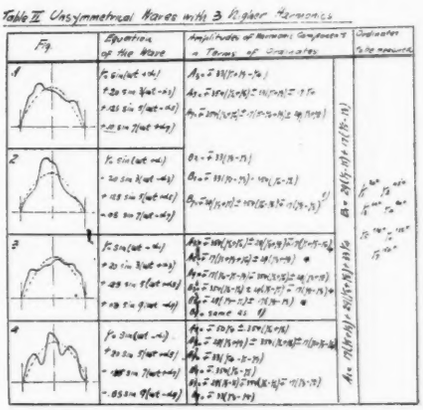


TABLE VI.—UNSYMMETRICAL WAVES WITH THREE HIGHER HARMONICS.

frequency, a displacement of $y_{max.}$ toward the right is the result of a leading E_1, while if E_1 lags $y_{max.}$ is located to the left of y^{90}. As to the formulas, we note that A_1, as well as the numerical values of the components, A_3, A_5, B_3, B_5, are given by the formulas:

$$A_1 = .354\,(y^{45} + y^{135}) + .50y^{90}$$
$$A_3 = A_5 = .354\,(y^{45} + y^{135}) - .50y^{90}$$
$$B_1 = B_3 = B_5 = .354\,(y^{135} - y^{45})$$

(b) Table V. Unsymmetrical waves with two higher harmonics.—Of the eight waves shown in this table, the Figs. 1 to 4, and Figs. 7 and 8, are often met with in practice. In particular, waves with a third and a fifth harmonic, as shown in the first half of the table, are quite frequently encountered. The understanding of the typical features of the waves should not present any difficulties. As to the contents of the third column, we may be permitted to add that, if the harmonic component under consideration is of the positive sign, the formulas with the signs in the lower row are the correct ones, otherwise the signs in the top row should be substituted. Considering, however, that we are not concerned at all about the time-phase relation between the individual harmonics, we may ignore the signs in the top row. Indeed, what we are after are the numerical values of the harmonics, which are readily obtained by the application of one and the same formula, no matter whether the component under consideration is of the positive or the negative sign. To illustrate: In the formula

$$B_1 = + .354\,(y^{135} - y^{45})$$

the numerical value obtained in either case is the same, the only difference in the result being, either, a + or a — sign prefixed to the number found. Later on in the present paper we shall return to this subject.

(c) Table VI. Unsymmetrical waves with three higher harmonics.—In this last table, four unsymmetrical waves with three higher harmonics each, have been reproduced. Figs. 3 and 4 have been given space in the table with the object in view of illustrating the effect of a ninth harmonic, the amplitude of which is about five to eight per cent of that of the fundamental wave. It has been pointed out above, that in waves with more than two higher harmonics, especially with unsymmetrical waves, as a rule no prominent ninth harmonic is to be expected. Keeping this in mind, the formulas applying to waves with three higher harmonics, are reduced to those accompanying Figs. 1 and 2.

V. Summary and Conclusion.

With the discussion of the contents of Table VI, we have concluded what might be called the theoretical part of the present paper, thus preparing us to take up the more important part, that is, the practical side of the subject. The introduction to this article contains the statement, that, if the distortion of wave shape must be taken into account, it suffices to determine the amplitudes of the fundamental wave, and one, or, at the utmost, two, terms of higher order. In the following, we shall extract from the tables those formulas which enable us to resolve any distorted wave into its harmonic components, with a minimum expenditure of time. We shall also briefly consider a few instances where a distortion of wave shape may be a disturbing factor in heavy current work (power apparatus or power transmission). Let us first establish our formulas for practical work. The practical analysis of distorted waves may be confined to the determination of the amplitudes of (a) the fundamental wave, (b) the principal harmonic, (c) that of the harmonic succeeding the principal one in regard to order. Thus in waves with a principal triple harmonic, besides E_1, we should find E_3 and E_5. In curves with a principal fifth harmonic, we should arrive at the values of E_5 and E_7. Generally speaking, then, if we develop the formulas for E_1, E_3, E_5, E_7, the analysis of any distorted wave is reduced to the measurement of a few ordinates and the application of from two to three extremely simple formulas.

If the oscillogram reveals, besides the principal harmonic, the presence of harmonics of higher order, that is, if the

wave cannot be treated as a curve with one or two higher harmonics (Tables I, II, IV, V), all waves, whether symmetrical or unsymmetrical, should be considered as consisting of a fundamental wave and three higher harmonics. We now apply the following general formulas:

(A) DETERMINATION OF E_1.

(α) For symmetrical waves:

$$E_1 = .33\,(ya + yd) + .58yc \qquad (I)$$

(β) For unsymmetrical waves[1]

$$A_1 = .17\,(ya + yg) + .29\,(yc + ye) + .33yd$$

$$B_1 = .29\,(yg - ya) + .17\,(ye - yc) \qquad (II)$$

The formulas cited give exact results, if the order of the highest harmonic present does not exceed nine. Should a wave contain all odd harmonics, up to and including E_{13}, the formulas (I) and (II) furnish $E_1 + E_{11} + E_{13}$. Apart from the fact that E_{11} and E_{13} are negligible in magnitude, the chances are that they will completely, or almost completely, cancel one another in the equation. The formulas given for E_1 are thus correct in all cases, no matter what harmonics are present.

(B) DETERMINATION OF E_3.

(α) For symmetrical waves

$$E_3 = .67ya - .33yd \qquad (III)$$

(β) For unsymmetrical waves

$$A_3 = .33\,(ya + yg - yd)$$

$$B_3 = .33\,(ye - yc) \qquad (IV)$$

These formulas give exact results, so long as the complex wave does not contain a ninth harmonic of appreciable magnitude. If the presence of a ninth harmonic is indicated by nine singularities in the complex wave, the formulas marked with + in Table III, Fig. 5, for symmetrical waves, and Table VI, Fig. 3, for unsymmetrical waves should be employed.

(C) DETERMINATION OF E_5.

(α) For symmetrical waves

$$E_5 = .67ya - .71yb + .17yd \qquad (V)$$

(β) For unsymmetrical waves

$$A_5 = .354\,(yb + yf) - .33\,(ya + yg) + .17yd \qquad (VI)$$

Here, too, the formulas are mathematically correct in all instances where there is no appreciable ninth harmonic present. If the oscillogram reveals the presence of a noticeable ninth harmonic, the formulas marked with * in Tables III and IV should be substituted.

(D) DETERMINATION OF E_7.

Although in the majority of instances it will be sufficient to determine E_1, E_3, and E_5, in exceptional cases it might become desirable to arrive at the numerical value of E_7 also. We are enabled to do this with the aid of the formulas:

(α) For symmetrical waves

$$E_7 = .33ya + .58yc - .71yb - .17yd \qquad (VII)$$

(β) For unsymmetrical waves

$$A_7 = .354\,(yb + yf) + .17\,(ya - yd + yg) + .29\,(yc + ye)$$

$$B_7 = .29\,(yg + ya) - .354\,(yf - yb) \qquad (VIII)$$

Having thus established a few simple formulas with the assistance of which we may resolve any complex wave into its principal constituents, we shall briefly consider a few instances where higher harmonics may be a disturbing element in heavy current work. A distortion of wave shape, if considerable, might affect the hysteresis loss in the magnetic circuit of motors or transformers. It has been shown[1] conclusively, that a pressure wave of the peaked type, which gives rise to a flat-topped magnetic wave, entails a larger, while a peaked magnetic wave, which will result if a flat-topped pressure wave is acting in the circuit, causes a smaller hysteresis loss than a true sine wave of the same effective value. All we require in order to predetermine the approximate hysteresis loss, if the wave of impressed voltage deviates considerably from the true sine form, is the ratio $\frac{E_{max.}}{E_{eff.}}$ = electromotive-force factor. This may be accomplished by applying formulas I to IV, or, if the wave is unsymmetrical, formulas II to VI.

A considerable distortion of wave shape might also affect the performance of induction or synchronous motors. Here, if the distortion of the voltage wave acting at the motor terminals is considerable, the rotating field produced will be more or less of a pulsating character. Induction motors might operate uneconomically with probably dead points in the starting torque, or considerable counter torque during running. Synchronous motors or rotaries may hunt, or even fall out of step. Or if the wave shape of induced counter-electromotive-force greatly differs from the pressure wave acting at the terminals of a synchronous motor or rotary there might be excessive heating, thus lowering the efficiency of the system. These results are, of course, to be expected only if the distortion is considerable. Probably without exception the disturbing factors are the third and perhaps the fifth harmonic, which may be most easily determined by availing ourselves of formulas I, III, V, or II, IV, VI.

Besides the two points just mentioned, there is a possibility of disturbing elements in power transmission work if the pressure waves are badly distorted. Resonance or consonance may result, thus giving rise to excessive voltages at certain points of the line. Unless the distortion is noticeable to a marked degree trouble from this source need not be expected.

It is beyond the scope of this paper to discuss in detail the effects of higher harmonics.

In conclusion, the writer wishes to emphasize that the method expounded in the above is not to supersede any other mathematical method. It must be repeated that these formulas are mathematically correct only so long as the order of the highest harmonic does not exceed nine. Considering, however, that harmonics of the order eleven or thirteen or even higher, provided they are present at all in pressure waves obtained from modern alternators (see footnote 2), will never entail any consequences in heavy current work, it is maintained that these formulas are mathematically correct and sufficient for all requirements of engineering practice.

A few words may be added pertaining to the illustrations accompanying this paper. The following considerations prompted the writer to compile the tables I to VI in addition to Figs. A to G, inclusive. Firstly, quite often we are dealing with typical waves, such as are represented in Figs. 1 to 4, Table I; Figs. 1 to 8, Table IV; Figs. 1 to 4, and 7 and 8, Table II and Table V. If the wave to be analyzed happens to be one of these, the simple formulas given with each figure may be made use of. Secondly, to those not so familiar with the phenomenon of distorted waves, the illustrations might be welcome as a means to study the effect of higher harmonics of a certain magnitude, upon the appearance of the wave. Lastly, instead of putting down final formulas without showing how they were obtained, it was considered advisable to go through the entire course of their development.

[1] Here and in the following formulas we use the symbols

$ya = y^{30}$; $yb = y^{45}$; $yc = y^{60}$; $yd = y^{90}$

$ye = y^{120}$; $yf = y^{135}$; $yg = y^{150}$

[1] See article by Dr. Benischke, *Elect. Tech. Zeitsch.*, 1906.

An International Cotton Exposition.

An International Cotton and Fiber Exposition will be held in London, in 1912, in conjunction with a conference for the purpose of thoroughly considering the cotton question. It is expected that many novel exhibits of electric drive for cotton-mill machinery will be shown.

ELECTRICAL EQUIPMENT OF THE BATTLE CREEK SHOPS OF THE GRAND TRUNK RAILROAD.

BY L. C. BROWN.

As a good example of the uses to which electrical apparatus is put in the modern locomotive repair shops, the Battle Creek (Michigan) shops of the Grand Trunk Railroad stand out very prominently. The shops are new, and consist of a group of four buildings, viz., the office building, the forge shop, the power house and the main or locomotive shop. All of the buildings are of modern fireproof brick, concrete and steel construction, and are connected by industrial railway tracks and a ten-ton yard crane running from the receiving track over the "midway" between the office building, store rooms and power house on one side, and the locomotive and forge shops on the other. The power house and locomotive shops are, from the electrical viewpoint, of most interest.

The plant is primarily an alternating-current plant, direct current being used for variable-speed machine tools and cranes only. The 120-ton crane, the plate-bending rolls and others of the larger variable-speed tools are exceptions to this rule, and are driven by phase-wound induction motors. The lighting system is also alternating current, the yards being lighted by twenty-five 6.6-ampere, Western Electric, enclosed, series arc lamps, and the interior shop lighting being taken care of by 140 type "F," 254-volt Cooper-Hewitt lamps. As a whole the plant is a well-balanced combination of alternating and direct-current driven machinery. It is also a splendid example of proper combination of individual and group-driven apparatus.

The power house is actually more nearly a substation than a generating station. Under normal operating conditions the entire power is supplied by the local Edison company from a 4,750-volt, three-phase, sixty-cycle transmission line. This is stepped down by three 250-kilowatt transformers, connected in delta, to 440 volts for local transmission. There are also three seventy-five-kilowatt, 4,750 and 440 to 152-volt transformers for feeding a 200-kilowatt, 250-volt, 900-revolutions-per-minute rotary converter with an engine-driven exciter. As a reserve unit there is in the power house, a 200-kilowatt, 440-volt, three-phase, sixty-cycle, 150-revolutions-per-minute alternator direct-connected to a Wisconsin Engine Company sixteen by thirty simple Corliss engine. Steam is supplied by a battery of four hand-fired boilers at 300 pounds pressure.

The switchboard is of oiled slate, and consists of fourteen panels for the control of the incoming, alternator, exciter, rotary, arc lamp and several shop circuits. The board is arranged so that the rotary may be supplied by the seventy-five-kilowatt transformers, stepping down from the 4,750-volt line, or by the same transformers, using the 440-volt taps, to step down from the alternator voltage to the 152 volts required by the converter. There is also a synchronizing panel for the alternator when running in parallel with the Edison circuit. The board is fully supplied with oil switches, indicating and recording wattmeters, voltmeters, etc.

The locomotive shop is a structure 825 by 175 feet, running north and south. This is subdivided by a brick fire wall into a machine and erecting shop, and a boiler and tank shop, the latter occupying 200 feet of the south end. This portion is subdivided into four bays, running east and west, or across the building. Each bay is equipped with an overhead traveling crane.

The machine and erecting shop is divided into three bays running with the length of the building. The eastern bay, shown in Fig. 1, is for erection, and contains twenty-five pits; over these travel a ten-ton and a 120-ton crane. The latter is the alternating-current crane referred to previously. All the cranes were furnished by the Morgan Engineering Company. The central bay, shown in Fig. 2, is for the heavy machine work. The western bay, shown in Fig. 3, over which a balcony extends, is devoted to the lighter machine tools. The group-drive motors for these lighter machine tools are shown arranged on the platforms mounted on the roof columns at the east side of the bay. The greater portion of the roof is of the saw-tooth construction, and in every bay thus formed are suspended three Cooper-Hewitt lamps. These are spaced approximately twenty-four feet apart lengthwise, and sixty-five feet apart crosswise of the shop. These lamps, with the exception of those over the erecting pits, are thirty-six feet above the floor level. Those over the pits are fifty feet above the floor. Upon entering this building one is much impressed by the excellent system of lighting, due both to the electric lights and generous window space; and also by the well-kept appearance of the equipment because of the strict system of cleanliness enforced by the management.

From the power house to the locomotive

FIG. 1.—ERECTING PIT BAY OF LOCOMOTIVE SHOP.

FIG. 2.—HEAVY MACHINE-TOOL BAY OF LOCOMOTIVE SHOP.

shop there are five 250,000-circular mil, three-conductor, rubber and lead-covered cables for the alternating current and two

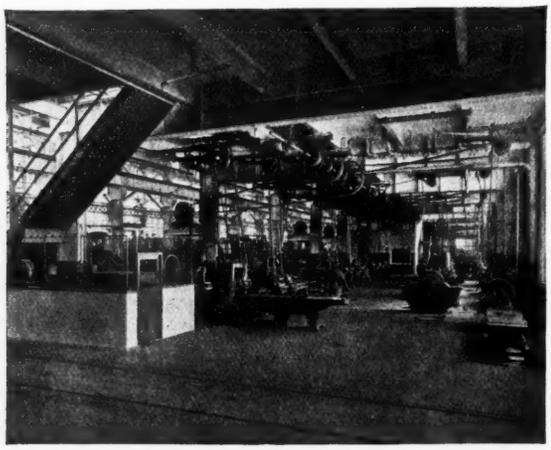


FIG. 3.—LIGHT MACHINE-TOOL BAY, SHOWING MOTORS FOR GROUP DRIVES.

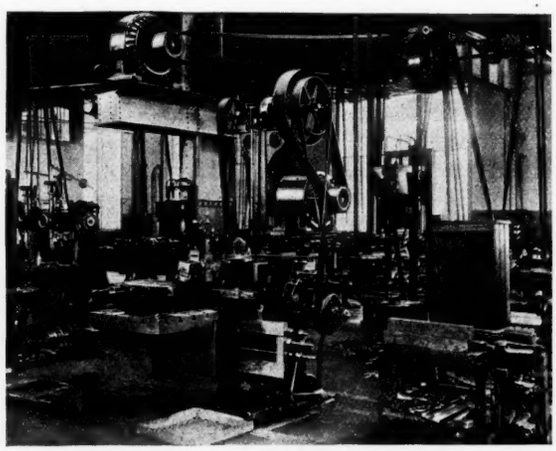


FIG. 6.—SHOWING MOTORS FOR BOTH ALTERNATING-CURRENT AND DIRECT-CURRENT GROUP AND DIRECT DRIVE IN MACHINE SHOP.

1,000,000 centimetre direct-current cables laid in two three-multiple ducts. These cables enter the locomotive shop

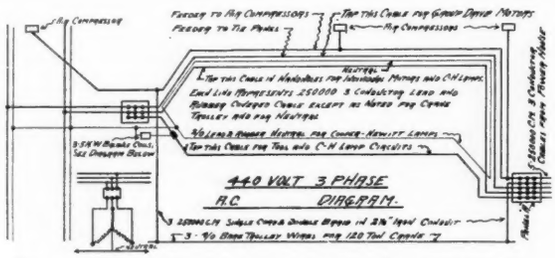


FIG. 4.—440-VOLT, THREE-PHASE WIRING DIAGRAM.

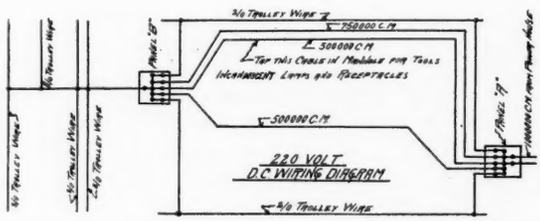


FIG. 5.—220-VOLT, DIRECT-CURRENT WIRING DIAGRAM.

through a manhole and panel "A" in the accompanying diagrams, Figs. 4 and 5. Referring to these diagrams, it will be

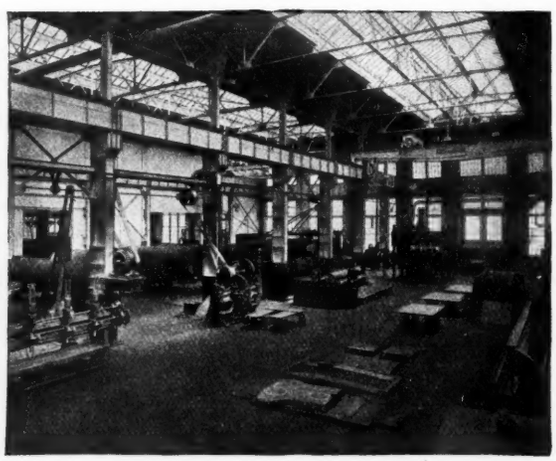


FIG. 7.—BOILER SHOP, SHOWING MOTOR-DRIVEN PLATE ROLLS AND HYDRAULIC PRESS.

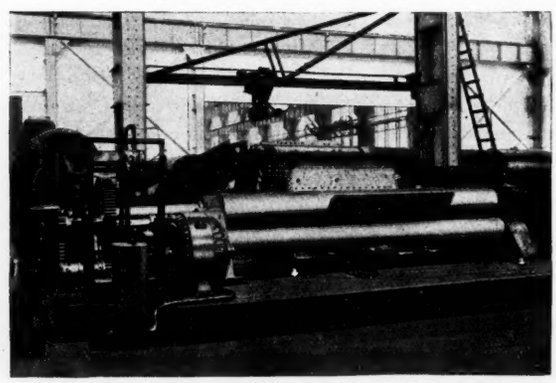


FIG. 8.—MOTOR DIRECT-CONNECTED TO BENDING ROLLS.

seen that there are three lines of conductors. The one along the edge of the balcony on the west side of the building,

single three-multiple duct. These two lines of ducts are tapped every twenty-four feet by two foot by two foot hand-holes, with room for six service boxes in each. The leads are carried from these hand-holes to the motors in one-inch conduit. The third line of conductors is composed of the crane trolleys, these being used in parallel with the regular three-

closest to the air compressors in the first diagram, is carried in two three-multiple ducts. The central lines are carried in a

The alternating-current cables are tied together at panel "A" into two circuits, see Fig. 4. The lighter one, composed of two sets of the incoming cables, is used for the three 100-horsepower air compressors and the 120-ton crane. The second line, made up of three incoming cables, sends two cables through the west and one through the central ducts. One

conductor cables in the other lines, thereby reducing considerably the size of cable required.

of these cables is for group motors only; the other two are for individual-drive-tool motors and one side of the Cooper-Hewitt lamp circuits. These latter three cables are again tied together at panel "B," and from this point two cables, for all purposes, are run into the boiler and tank shop. At panel "B" the cable for individual motors and lamps is tapped and three five-kilowatt balance coils connected in Y across the three conductors of the cable. From the center of the Y a neutral is brought out and run through the central and west ducts, as shown. Across this neutral and each of the three conductors of the cables "for C-H lamps," the lamp load being divided equally between the three phases, are connected the 254-volt Cooper-Hewitt lamps. This method has proved very satisfactory.

The two direct-current cables from the power house are tied together at panel "A" and again split up into five sets of leads, see Fig. 5. Three of these are pairs of single-conductor cables, and the other two leads are the trolley wires of the two ten-ton cranes over the machine and erecting shop. At panel "B" these are again all tied together and one circuit run to the four bays of the boiler and tank shop. The wiring was done by the construction department of the Western Electric Company.

As before stated, most of the variable-speed machine tools are driven by direct-current motors. These motors are all of the interpole type and give speed variations of from one to two up to one to four, depending upon the requirements of the tool driven. All of the motors are on the 220-volt circuits. The motors are controlled from individual panels, built up of angle irons, on which are mounted a fuse box, an automatic oil switch and a drum-type reversible controller. The controllers were furnished by the Cutler-Hammer Manufacturing Company. The view of the machine shop, Fig. 6, is a splendid illustration of how nicely the alternating and direct-current machinery is made to work together. In the upper portion of the photograph is seen one of the group-drive motors taking care of its load of small machine tools located under the balcony. In the foreground there is an interpole direct-current motor mounted on and belted to a shaper which requires variable-speed drive. To the right of this motor is the panel for its control. The controller itself is mounted close to the floor, where it is readily accessible.

A Ryerson flue rattler for cleaning scale from removed boiler tubes is driven by a twenty-five horsepower motor and the twelve-foot plate-bending rolls by a thirty-five-horsepower motor. Both are phase-wound rotor induction motors giving one to two speed variation. A general view of the boiler room is shown in Fig. 7, with hydraulic press at the end and bending rolls in the center. This bending roll, with its geared motor and controller, is also shown in Fig. 8. Just above the roll will be noted a horizontally swinging stay bolt drill, which is driven by a small direct-current motor mounted on the column to which the drill is hung. The transmission from the motor to the drill is by means of the horizontal shaft and sliding bevel, pinion and gear.

All the larger constant-speed machine tools have individual squirrel-cage, induction-motor drives. For example: Sixty-inch planers with twenty-five horsepower motors, sixty-inch shears with ten-horsepower motors, 400-ton hydraulic press with fifteen-horsepower motors, radial drills with various size motors, etc. One of the sixty-inch planers with its two driving motors, each twenty-five horsepower, mounted on top, is shown in Fig. 9. Fig. 10 is a view of the 400-ton hydraulic press, for forcing drivers on their axles. Mounted on the back of it is a geared motor for driving the triplex pump used to produce the hydraulic pressure. These motors each have individual starting panels. In connection with the individual drive it should be stated that, as many of the machine tools were old and not arranged for motor drive, J. T. McGrath, master mechanic of the shop, has made many ingenious mountings for the motors.

Next in the motor equipment come the smaller machine tools. These are combined together in sixteen groups; ten of twenty, five of thirty and one of forty horsepower demand. These group motors are mounted on wooden platforms built up on two channel irons which are riveted to the roof columns of the building. This arrangement puts the motor well up out of the way of the workingmen and also in good position relative to the line shaft. Under each motor is set up its control panel, similar to the individual motor panels, each having a fuse box, an automatic oil switch and a Western Electric auto-starter. The arrangement of the group drives is clearly shown in Fig. 11, which is a photograph of one of the groups on the balcony of the locomotive shop, shown in Fig. 3. The platform of channel irons is clearly shown. Under the motor is to be seen its panel. The conduit for the power line, up to the panel and from the panel to the motor does away with all the fire hazards and complications of open wiring. This method of wiring has been followed throughout the shop where it has been

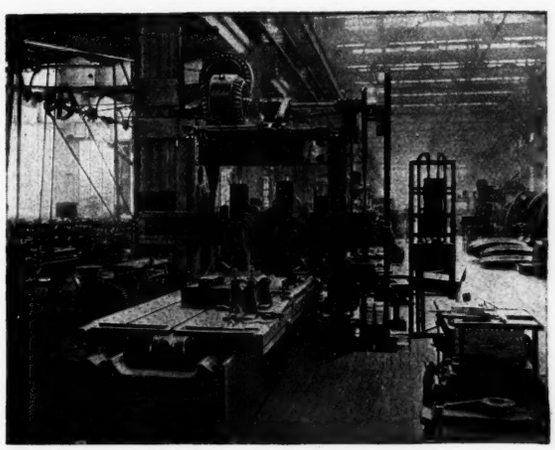


FIG. 9.—SIXTY-INCH PLANER DIRECT-DRIVEN BY TWO TWENTY-FIVE-HORSEPOWER MOTORS.

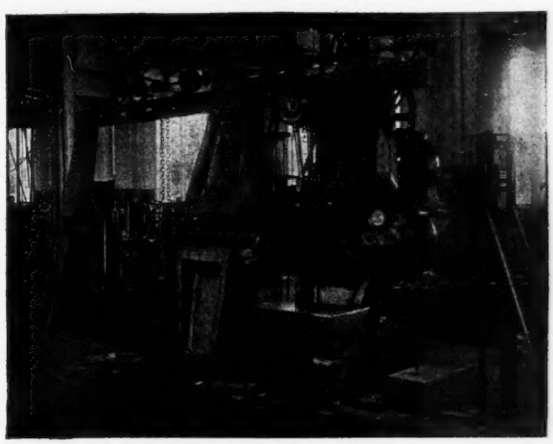


FIG. 10.—MOTOR MOUNTED ON AND CONNECTED TO 400-TON WHEEL PRESS.

necessary to run the leads above the floor.

Another distinctive use to which motor drive is put is in the hydraulic system. In this system a pressure of 1,500 pounds per square inch is maintained by the accumulator, a tank filled with scrap iron and having approximately twelve-foot vertical play, and two three by eight triplex Goulds pumps driven by two forty-horsepower geared Hawthorn phase-wound induction motors. The pumps are controlled by float switches and Cutler-Hammer automatic controllers. The hydraulic pressure is used to operate two shears, a punch and a bulldozer in the forge shop, and a 500-ton press for shaping boiler plates, etc., in the boiler shop. In addition to this system there are 200-ton and 400-ton individually-driven hydraulic presses. The pump equipment is shown in Fig. 12. It comprises a ten-horsepower motor for the 200-ton and a fifteen-horsepower motor for the 400-ton presses, the pumps being located just behind the motors on either side of the column. The accumulator is the tank to be seen back of and to the left of the roof column. In the illustration it is shown at about the lowest point of its vertical movement. The secondary resistance grids, for the motor control, are mounted on the left of the column, while the controlling panel is behind it.

On the column, in this same picture, will be noted the valves and tap, with hose attached, for compressed air; and just above this a plug, connected to the direct-current circuits, for the attachment of portable lamps and small motor-driven tools. On each column, throughout the locomotive shop, is mounted a similar equipment.

In this shop compressed air is used for many portable tools, for small hoists, for cleaning out cylinders, etc., and for driving some of the very high-speed machine tools, such as packing-ring turning and grinding tools. All the forges and welding machines burn crude oil, which is forced from the storage tanks to the forges, and there atomized by compressed air. Also all the lubricating and other oils are forced from the storage tanks outside into the petty store rooms by aid of compressed air. All of the air used is furnished by three Ingersoll-Rand, two-stage compressors direct-driven by Western Electric induction motors with a total horsepower of 106. Cutler-Hammer automatic control is used. The motor is mounted directly on the shaft of the compressor and is set partially in a pit so as to bring it down into alignment with the shaft.

With the exception of a very few of those on the older tools, the entire motor equipment was furnished by the Western Electric Company. The Arnold Company, of Chicago, engineers and constructors, had entire charge of the design and erection of these shops.

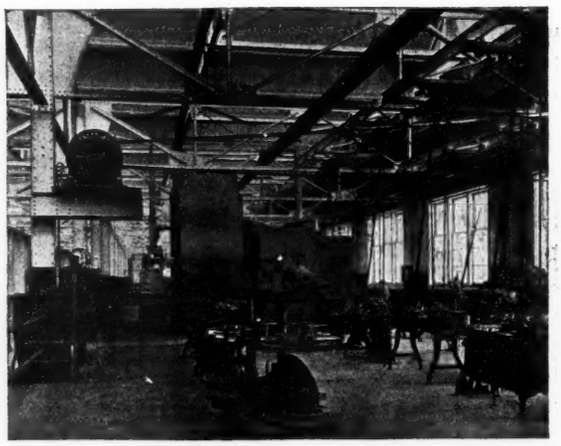


FIG. 11.—GROUP DRIVE ON BALCONY OF LOCOMOTIVE SHOP, SHOWING METHOD OF MOUNTING HAWTHORN INDUCTION MOTORS AND CONTROLLING APPARATUS.

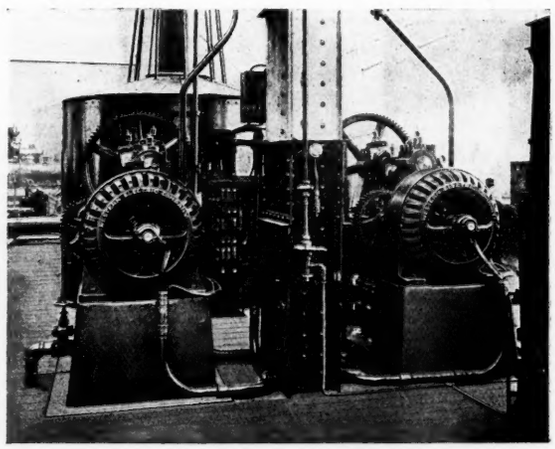


FIG. 12.—HYDRAULIC PUMPS DIRECT-CONNECTED TO TWO HAWTHORN INDUCTION MOTORS.

Secrecy in Wireless Transmission.

News dispatches from Seattle, Wash., announce that absolute secrecy in wireless telegraphy has been discovered and that important experiments have been conducted from the Aberdeen (Wash.) station of the United Wireless Telegraph Company. The men who have worked out the scheme are said to be R. H. Armstrong, Pacific Coast manager; C. H. Thomas, chief operator, and Mr. Dent, the company's operator at Aberdeen. The station was completed a few months ago.

The Function of the Electric Furnace.

A recent article in *Electro-Chemical and Metallurgical Industry* discusses the commercial aspect of the electric furnace. It should not be overlooked that the introduction of the electric steel furnace does not mean the scrapping of existing metallurgical plants. The electric furnace is not a competitor, but a supplement to existing plants. The electric furnace not only does not mean scrapping of old plant, but it seems destined to prevent the scrapping of old plant, as it promises to give a new lease of life to the converter. The general tendency of recent years has been away from converter steel toward open-hearth steel. It is at this point that the electric process steps in, since the combination of the converter with the electric furnace should satisfy all reasonable requirements. This fact and the undeniable tendency of the times to demand better steel for general purposes, are considerations of utmost importance, if it is questioned whether the cost of electric-steel refining is worth the price.

Regenerated Rubber.

A new process for the regeneration of vulcanized rubber has, says the *Scientific American,* been recently patented in Germany, which should prove of considerable value. Fragments of old rubber are mixed with from one-tenth to one-fifth their weight of anilin, and the mixture is heated until it becomes fluid. The special advantage of the process is the comparatively small quantity of solvent required. The regenerated rubber is said to be little inferior to new rubber in elasticity and other properties. It can be vulcanized in the usual way and regenerated again by the new process.

A Notable Address by Caryl D. Haskins.

At a meeting of the Brooklyn Company Section of the National Electric Light Association, June 23, 1909, Caryl D. Haskins delivered the chief address, an abstract of which follows:

Mr. Haskins dealt in order with his early reminiscences, with the things of today, and with those things which may be accomplished in the future.

His first memory of the electric-lighting industry carried him back a period of twenty-one years when he started out as a Yankee boy from New England to be identified with one of the very early central-station companies of Great Britain in the old "Grosvenor Gallery Station." In that undertaking he was associated with the late Lord Kelvin, Sir William Thompson in those days, and a little of his very earliest work he was very fortunate in carrying out under that eminent master's instruction. A little later the Grosvenor Gallery Station gave birth to the Deptford Station, an undertaking which was considered extremely large and daring in those days. It contemplated a 10,000-horsepower generator, something so far beyond anything which had been considered prior to that time as to be regarded as quite visionary. In addition to this there were to be two 2,500-horsepower units of the same general type. This station was designed to deliver current over the mains into London at 10,000 volts, an epoch-making event for those early days. Mr. Haskins worked on the plans, but returned home before the station was completed.

On the switchboard in the old Grosvenor Gallery Station the 2,500-volt circuits were handled by means of knife-blade switches, and for use in switching there were provided two pieces of two-inch belting about two feet long, each with a wooden handle. The rule was to take the switch firmly in the right hand and the piece of belting firmly in the other, pull out the switch, and "swat" the arm (laughter). There were very few accidents, and all of these, in fact, in his time were on the mechanical end.

He came home to America about 1889 and took up the work here where it was about as crude, if not cruder, in many respects, as it was in England. He told of a notebook of rules which was in daily use by a meter inspector, in which he found the following excruciatingly funny erty: "Rule for testing recording meters on power service. Examine the installation. Estimate the work being done by the motor and horsepowers—multiply by 746. If meter checks within ten per cent, correct (laughter). If not, estimate the horsepower again" (more laughter).

Mr. Haskins went on to tell about the things which have been achieved by the electrical and mechanical engineers in the past twenty years. He digressed a little to tell of one of the most treasured books in his little library, "Evans' Steam Engineer's Guide," written in Philadelphia in the year 1805. This excellent little treatise, which was away ahead of its day, told of Mr. Evans' efforts to introduce high-pressure steam in steam-engine practice, and, what the speaker alluded more particularly to, his heroic endeavors to project a steam road from Philadelphia to Washington, which failed because of his inability to raise the necessary $8,000 to put the scheme through! That was in 1805.

Mr. Haskins gave some remarkable statistics of the electric-light and power industry in the United States and of its astonishing increase within the last few years. He deservedly gave most of the credit of this huge enterprise to the electric-light men. He went on to speak of the other electrical wonders of the present day, of the X-ray, the wireless telegraph, the wireless telephone, and of the application of electricity to the promotion of vegetable growth. He told of a farm in Idaho of thousands of acres devoted to wheat and alfalfa where every field has its electrical service and where traction vehicles, loaded with alfalfa or wheat, run on temporarily strung trolley wires to the barns. The owner of that farm claims a saving of fifty per cent in operating expense over the old horse and man system. He spoke also of a dairy farm where the handling of the product, the churning of the butter, and especially the milking, are all done electricially. The farmer gets probably two cents a quart more for his milk because he is able to certify that the milk never gets to the air. Even the gas-makers have to use electricity, and as one gas man said to the speaker recently, "Of course, we don't advertise it, but electricity is really the only safe thing to light a gasworks with" (laughter).

Mr. Haskins did not arrogate all the credit for this electrical enterprise to the electric-light men; a great deal of credit must be given to the man behind the gun —the banker. "Bear in mind," he said, "that in 1805 Evans could not raise $8,000 to build a steam traction system from Philadelphia to Washington. In this short twenty years the bankers have had the faith and the confidence to put over a billion of dollars behind us and keep it there! It is the banker, after all, who has contributed quite as much as we to these great works."

Mr. Haskins doubted whether the engineering progress of today, however, is materially more rapid than it was 2,000 years ago; we only saw it better. This was brought home to him in a marvelous way some four years ago during a little exploring trip to Mexico, when he saw a great stone structure covering three acres, a Toltec Temple. No English-speaking man probably had ever seen it before. It stands on the summit of a steep hill, in a country where building rock is scarce. It is a solid mass of masonry and probably not a single stone in it weighed less than two tons! It took engineers to do that job, and those engineers did their work so long ago that not only are they forgotten, but their race is forgotten. Doubtless they said, "We are the first real engineers. Engineering progress has been initiated in our day. Look at that pile of rocks." That is just about what we are saying of electric light.

Mr. Haskins proceeded to look forward into the future. The work ahead, he said, is so gigantic as compared with what has been done that it dwarfs the past and the present. Probably the first great work in the electrical industry will be the banishing of the small central stations. These must be all replaced by a series of great systems, which will spread out and overlap and some day cover the entire country with a few great networks. Good engineering and good banking both dictate this, and in this way we shall give service not to one-half of the population as at present, but at least to eighty per cent of all the people. Another and vastly bigger problem is that of our rapidly diminishing coal deposits. In spite of the vast deposits which are as yet unworked all our coal will eventually be used up. Where then shall we turn? Tide power!—wave power!—plentiful but very expensive to develop. There is the power of the sun! In this we have a great resource of which we will probably take advantage. The power of the winds is one of our greatest potential assets, and Mr. Haskins told in a most interesting way of the extraordinary development of windmills in Holland, where they have a windmill commission which is quite as active as our own public service commission. We have already done some considerable work in this line ourselves, as for instance in Kansas, where the traveler may see in the daytime a constant procession of wind-

mills marching across the horizon. Some day, perhaps, the wind will help us out when our coal becomes exhausted.

A great deal can be done, however, by us wasteful Americans, toward retrenchment and economy. Houses must be made coldproof. Every house should be a sort of a thermos bottle, so that the heat we put into the house must not be allowed to radiate from it. When this is done—and it is not at all incompatible with good ventilation—the number of heat units which must be put into the house will be greatly reduced and the efficient burning of coals under our boilers will be a practical and economic possibility. Possibly, though, the emergency will not be met in this way. We Americans are a prosperous and a wasteful race. The advertising matter that an ordinary business man daily throws away would yield enough heat units to heat the house, and besides furnish most of the lighting; and if this were not enough the garbage which we throw away would yield just enough alcohol to patch out!

Mr. Haskins continued in a prophetic and anticipatory vein. Perhaps, he said, some great scientist will learn how we can recover unlimited radium from unlimited pitch-blend, and how to use it without being killed in the endeavor. Perhaps, again, we shall face the disappearance of electricity. He told of a very prominent American scientist who, while he hated to think so, would not be surprised if 2,000 years from now we were using a fainter illuminant than we are at present. The efficiency of the firefly and of the numerous types of luminous sea animalculæ is roughly about fourteen times better than the efficiency of the best electric light when measured in heat units, and that he believed if a sufficient amount of money were put behind biologists in the next twenty years, we might very well so improve and develop sea animalculæ that every street lamp would be, in fact, an aquarium.

In conclusion Mr. Haskins touched briefly on the question of war, which, he said, is one great question to be solved by electrical men. War must be made such a dangerous pastime that no sane man dare undertake it. And in that great day, that millennium of tomorrow or next week, when any one of us can from a distance of about thirty miles push a button that will annihilate armies and melt down battleships at sea—and that is not so visionary as it sounds—then there are going to be no more battleships and armies, and we shall have no war.

The Association of Railway Telegraph Superintendents.

About seventy-five active members of the Association of Railway Telegraph Superintendents attended the twenty-eighth annual convention of this association at the Hotel Pontchartrain, Detroit, Mich., on June 23, 24, and 25 last, President W. J. Camp presiding. The delegates were welcomed by the mayor of Detroit and the vice-president of the Detroit Board of Commerce.

After some general business matters had been disposed of, W. K. Morley, of Grand Rapids, first vice-president and organizer of the association, presented an interesting address in which he told of the history of the association and the circumstances that led to its organization.

The committee, consisting of G. A. Cellar, chairman, G. H. Groce and C. Seldon, presented its report on "High-Tension Wire Crossings," in which 700 volts was recommended as a dividing line between low-tension and high-tension work, and specifications were given for overhead and for underground crossings of wires for various voltages.

A paper by H. P. Folsom on "The Preservation of Poles" was read. In the discussion J. McMillan, of Calgary, Alberta, superintendent of telegraph construction of the Canadian Pacific Railway in that district, mentioned the interesting fact that in his section of the country the poles began to decay, not at the ground line, but at a depth of from four to five feet below the surface.

Prof. J. C. Kelsey, in the course of an interesting paper on "Telephone Construction," presented specifications and data for standard work. Other papers were: "Efficiency of Office Organization," by J. B. Sheldon, of Omaha, Neb.; "Wire Testing and Care of Wires," by V. T. Kissinger, of Lincoln, Neb.; "Difference Between a Trouble-Shooter and a Division Lineman," by H. D. Leed, of St. Louis, Mo.; "Dry Batteries," by F. H. Loveridge, of Chicago, Ill.

The following officers were elected: President, John L. Davis, Chicago, Ill., of the Chicago & Eastern Illinois Railroad; vice-presidents, I. T. Dyer, Los Angeles, Cal., of the San Pedro, Los Angeles & Salt Lake Railroad, and George A. Cellar, Pittsburg, Pa., of the Pennsylvania Railroad (lines west of Pittsburg); secretary and treasurer, P. W. Drew, Chicago, of the Minnesota, St. Paul & Sault Ste. Marie Railroad (Chicago Division).

The next annual convention will be held at Los Angeles, Cal., in May, 1910.

The New York Street Railway Association.

The Street Railway Association of the State of New York held its twenty-seventh annual convention at the Hotel Champlain, Bluff Point, N. Y., June 29-30, last, inasmuch as the Fort William Henry Hotel at Lake George, where it was originally arranged to hold the meeting, was completely gutted by fire a few days previously.

W. L. Pattison, general counsel of the Plattsburg Traction Company, welcomed the delegates to Plattsburg, and stated that transportation on the lines of his company during the convention would be afforded those who wore the association badge.

After the secretary had made some general announcements, President Fassett then read his annual address.

Reports of the executive committee and of the treasurer followed, after which Arthur L. Linn, Jr., read a paper on "Electric-Railway Accounting," which was discussed at some considerable length.

In the afternoon, N. W. Bolen, superintendent of transportation, Public Service Railway of New Jersey, read a paper entitled "Schooling of Trainmen." This was also discussed at length.

President Fassett then introduced Ralph R. Rumery, expert appraiser of the State Board of Tax Commissioners, who read a paper entitled "The Work of the State Tax Commission." Several reports of committees followed, which concluded the first day's session.

The Wednesday session was opened with a paper by J. L. Davis on "Latest Improvements in Electric-Railway Apparatus," at the conclusion of which he read a memoir on automobile block systems.

A rising vote of thanks was then extended to President Fassett for his efficient conduct of the affairs of the association and the promptness with which he acted in changing the location of the convention after the fire already referred to.

The following officers were elected: President, E. F. Peck, general manager of the Schenectady Railway Company (see personal column); first vice-president, C. Gordon Reel, general manager of the Kingston Consolidated Railway Company; second vice-president, E. J. Cook, general manager of the Rochester Railway Company; treasurer, H. M. Beardsley, secretary and treasurer of the Elmira Water, Light and Railroad Company.

The next annual convention will be held at Rochester, N. Y.

Joint Convention of the Wisconsin Electric and Interurban Railway Association and the Northwestern Electrical Association.

A joint convention of the Wisconsin Electric and Interurban Railway Association and the Northwestern Electrical Association, was held at the Grand View Hotel, Chain o' Lakes, Waupaca, Wis., on June 28 and 29 last, at which sixteen electric-railway and lighting companies of the state were represented.

The feature of the convention was the amalgamation of the two associations under the name and title of the Wisconsin Electrical Association. Individual membership will cost $5 per year, and is given to all former individual members of the two associations. The Class A members, who alone possess voting powers, consist of companies which will be assessed one-tenth of one per cent of their gross receipts. The present debts of the Northwestern association, amounting to about $300, will be wiped out by various company members of the Wisconsin association, and it is intended to start with a clean sheet, dues being payable January 1, 1910, and thereafter yearly. No delinquent dues will be collected owing to the incompleteness of the records.

The following officers were selected by ballot to administer to the affairs of the new association to serve until the annual meeting in January, 1910: President, Ernest Gonzenbach, of Sheboygan, formerly president of the Northwestern association; first vice-president, Clement C. Smith, of Milwaukee, formerly president of the Wisconsin association; second vice-president, Irving P. Lord, of Waupaca; third vice-president, George B. Wheeler, of Eau Claire; secretary and treasurer, John S. Allen, of Lake Geneva, formerly secretary of the Northwestern association.

REPORT ON LEGISLATION.

The report on recent legislation in Wisconsin affecting public-utility companies was made by Attorney E. W. Fairchild, of Milwaukee, at the Monday morning session, June 28. Very little of such legislation, Mr. Fairchild said, had been passed during the last session, for the reason that the public-utility law providing for the commission has solved many of the problems in this connection.

The following matters concerning electric-railway companies were covered last session by amendments to the Wisconsin public-utility law: (1) The time before which companies may voluntarily give up their franchises and accept an indeterminate franchise under the power of the commission was extended from July 1, 1908, to January 1, 1911, the question as to whether all companies shall be forced to take this course to be reopened on this latter date. (2) A popular vote must be taken in a city or town before any public utility can be purchased by the municipality. (3) The law requiring the temperature in cars to be kept at seventy degrees under all conditions was altered to read "sixty to seventy degrees whenever reasonably profitable." (4) Waiting rooms are to be provided on interurban railways in towns of 150 population or over. (5) The burden of proof of carelessness of a person injured at a crossing is upon the railroad company. (6) The value limitation has been removed in the case of a person caught stealing electricity, thereby making prosecution much easier.

COAL PURCHASE ON A HEAT-UNIT RATING.

R. T. Gunn, general manager of the Eastern Wisconsin Railway and Light Company, Fond du Lac, presented his paper entitled "Purchase of Coal on Straight Contract or British Thermal Unit Basis."

Mr. Gunn said his company had demonstrated, after a year of investigation, that this was the only proper method of buying coal, and the better-class coal companies are only too wiling to sell coal on a guaranteed number of heat units per pound, and make settlements one way or the other, according as the coal exceeded the guarantee, or fell below it, on analyses at the end of each month. A small sample of each day's delivery should be taken as received, and carefully kept in airtight jars. These samples should be mixed and at the end of the month analyzed and tested. In showing how local conditions determined the question of economy in buying a cheap or a high grade of coal, Mr. Gunn instanced a case of a power plant equipped with two water-tube boilers, one boiler being sufficient to carry the load eighteen hours out of the twenty-four, the other being added for the peak load. In this case, where it would be impossible to clean the ash from the boiler during the eighteen hours' run with cheap coal, an additional boiler was saved by the use of a high-grade coal and a saving of $10,000 per annum was thereby effected. A great saving can always be obtained by forcing boilers to their maximum capacity, and laxity or inefficiency on the part of the firemen is a cause of great expense for the extra coal needlessly consumed.

Ernest Gonzenbach pointed out that a uniform steam pressure did not necessarily mean careful firing, and supported his contention by a case occurring in his experience, where, by a reform in firing methods, in a plant which presented a splendid steam chart, the monthly coal bill was cut down from $5,000 to $2,200.

J. R. Cravath, of Chicago, told of the use of the Venturi meter in the Rockford Electric Company's plant at Rockford, Ill., which gave a continuous record of the rate of boiler feed so that the man in charge of the fireroom would know beyond a doubt when the rate of water consumption is in excess of the rated load of the boilers in service, whereupon it was his duty to start an additional boiler, thereby tending to keep all the boilers in use up to their maximum capacity.

W. D. Voth, of Sheboygan, and W. E. Haseltine, of Ripon, gave their experiences on the success of a premium plan by which the power-house force is given a certain percentage of the saving effected in the operation of the plant from a fixed figure representing cost per kilowatt-hour or horsepower-hour.

R. M. Howard, of the Green Bay Traction Company, read a paper on "Summer Parks," which gave rise to an interesting discussion.

TUESDAY SESSION.

Prof. C. M. Jansky opened the Tuesday morning session with a paper and talk on the work that the University of Wisconsin is doing to educate scientifically in a popular manner those engaged in the various industries. Courses are carried on by correspondence and by occasional visits of instructors to places where classes may be formed.

UNDESIRABLE BUSINESS.

Ernest Gonzenbach gave the concluding address with a discussion on the undesirability of certain kinds of business. The electric-light man, he said, had by this time come to recognize that purely peak-load business is not desirable, involving as it does a large investment in apparatus with its consequent large interest and depreciation charges, and in return obtaining only a small yearly revenue. Railway men had apparently done all they could to pile business into peaks, by means of baseball and amusement parks, which, although they provided large crowds, involved the handling of these crowds in a comparatively short space of time, which was not profitable. He had discovered, however, that suburban business provided a considerable percentage of his revenue and consequently he was preparing to boost the idea of getting people to live in the country.

COMPILATION OF LOAD FACTORS.[1]

BY E. W. LLOYD.

With the rapid adoption of differential rates by central-station companies, based on consumers' load factors, it is absolutely necessary that the commercial man have some practical data on the load factor of different industries before he can arrive not only at the rate per kilowatt-hour which the consumer will earn, but at the quantity of electricity he will consume.

It is not many years since most every manufacturer thought the actual connected motor or lamp load was the real maximum load on his plant, but we know today that this is not true in a great majority of cases, and that the true maximum rarely exceeds seventy-five per cent of the connected load.

In arriving at the load factor of a given plant, already electrically driven, it becomes necessary to install maximum measuring instruments as well as wattmeters. On direct-current circuits, correct reading instruments are available, the instrument being of a type both efficient and cheap; but for measuring the maximum on alternating-current circuits we have not been so fortunate. So far as the author knows, there is not available today a cheap and efficient instrument for this service. There are some expensive printing meters on the market, but no central-station company could afford this expensive instrument for any but large users, and for this reason very few companies have been able to secure data on load factors that are at all reliable.

For the man in the commercial department it is necessary to have some information of this kind, and it is fortunate that some of the larger companies have been collecting information on load factors for some years. This information the author has endeavored to collect on the ordinary classes of business we are familiar with, for the use of commercial men selling electrical energy for power and lighting purposes. There are quite a number of industries outside the list mentioned in this paper, but unfortunately no reliable information is available at this time.

As before stated, a maximum measuring instrument to be used on alternating-current circuits not being available, the Commonwealth Edison Company, of Chicago, serving a territory with alternating-current circuits in which there were thousands of manufacturers, found it necessary to establish a schedule of maximum percentages, based on the average maximum of several thousand customers who had been using direct current for years. The following table is one that has been adopted for alternating-current power business exclusively:

	Per Cent of Connected Motor Load.
Installations under 10 horsepower, where only one motor is used	85
Installations under 10 horsepower, where more than one motor is used	75
Installations from 10 horsepower to 50 horsepower, both inclusive, irrespective of the number of motors	65
Installations over 50 horsepower, irrespective of the number of motors used.	55

The above table does not apply to customers having lighting service as well as power. It is probably at least ten per cent low should lighting be connected with the power.

While the above table may seem low to some for installations above fifty horsepower, we find from actual experience that it is often too high and that we are obliged to install instruments to register the proper maximum. Of course, where a large proportion of the installation consists of blowers or ice machines, or other machinery in this class, the percentages may be low, but generally speaking they are not. However, in order to protect the power company from demands greatly exceeding these percentages, a clause can be incorporated in contracts providing for a test of the maximum at any time.

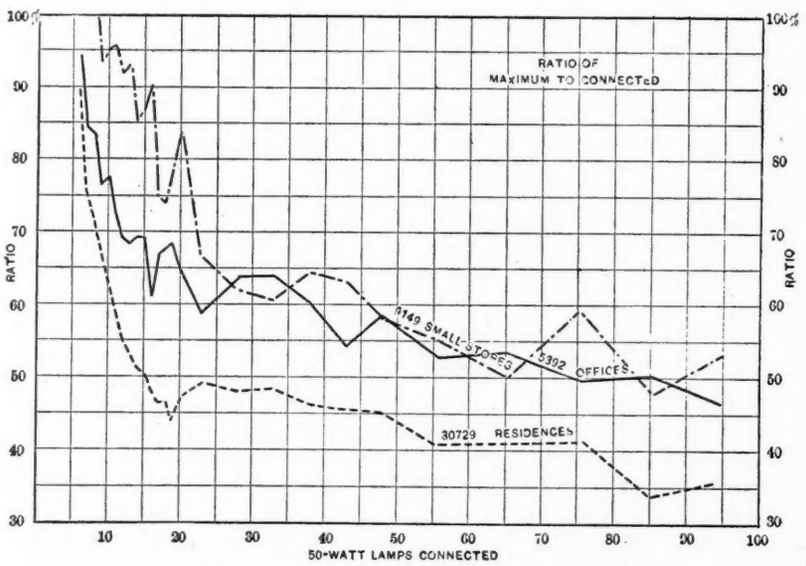
It may be interesting to know that we have found that out of 3,900 consumers of power, having installations aggregating 35,000 horsepower, the average maximum was 53.5 per cent of the connected motor load and that this was subdivided as follows:

	Customers.	Maximum Per Cent of Connected Motor Load.
Installations of 1 to 5 horsepower	2,900	75.4
Installations of 6 to 10 horsepower	456	64.5
Installations of 11 to 20 horsepower	237	64.7
Installations over 20 horsepower	307	42.9

A further subdivision of part of the above customers may be of value to some:

Total Installation in H. P.	Number of Customers.	Total H. P. Connected.	Average Maximum H. P.	Ratio of Max. to Conn. H. P.
1 Motor.				
1 to 5	1,177	2,165	1,862	86.1
6 to 10	124	1,036	676	65.3
11 to 20	32	492	303	61.6
Above 20	17	686	366	53.2
Total	1,350	4,379	3,207	73.3
2 Motors.				
1 to 5	177	412	285	69.1
6 to 10	51	387	261	67.4
11 to 20	30	438	288	65.9
Above 20	6	203	74	36.5
Total	264	1,440	908	63.0
3 to 5 Motors.				
1 to 5	150	381	314	82.5
6 to 10	42	290	238	82.1
11 to 20	33	475	329	69.3
Above 20	14	1,245	657	52.7
Total	239	2,391	1,538	64.3
6 to 10 Motors.				
1 to 5	42	121	80	66.0
6 to 10	21	157	98	62.4
11 to 20	10	155	98	63.1
Above 20	19	931	417	44.7
Total	92	1,364	693	50.8

An analysis of the load factors of over 50,000 consumers of electric light in many different classes should be interesting. The figures are taken from actual reading of watt and maximum meters, and are given on page 111.



CURVES SHOWING RELATION OF MAXIMUM TO CONNECTED LOAD.

The percentages in this table are not based on momentary peaks, but on peaks as registered by Wright demand meters.

For commercial reasons it would not be advisable for a selling company having steam-generating apparatus to establish any system of rates based on momentary peaks. Any ordinary steam plant is capa-

[1] A paper read before the annual convention of the National Electric Light Association, at Atlantic City, N. J., on June 3, 1909.

ble of taking care of ordinary overloads for at least fifteen minutes without undue strain on the apparatus. Therefore, it is unwise to use momentary peaks as the basis of determining a system of rates.

Considering an isolated plant, generating power for a given industry, this plant must be of such capacity that it can take care of the highest demand to be made on it. This high maximum condition may be during only one week of the year. Fixed charges in such a case are, therefore, greater in proportion to the units output than where the maximum is about the same from day to day. In such a plant the operating charges are also higher per unit generated, because the load factor is generally poor, the generating apparatus being less efficient under these conditions. It is scarcely necessary to point out that fixed charges continue as long as the plant does, and that no matter what the load factor of a plant may be these fixed charges are always the same. Generally speaking, they consist of interest, depreciation, taxes, insurance and rental value of space. After fixed charges are taken care of it becomes necessary to pay for the operation of the plant. These operating charges are labor, fuel, water, supplies, repairs, removal of ashes, lamps, and the like.

In making up a system of rates based on the load factors of possible customers, it therefore seems reasonable to have what are known as primary and secondary charges; the primary charge to consist of a price per kilowatt-year of demand, and a secondary charge per kilowatt-hour. This method of charging has already been adopted by some of the larger central-station companies and is steadily growing in favor. In the use of such systems of charging it is necessary to have information as to the maximum demand as well as the kilowatt-hours' consumption of a possible consumer.

We have succeeded in collecting a large amount of information relative to load factors of different kinds of manufacturing business. These load factors were taken on plants that operated normally during a fifty-four-hour week. Such businesses as department stores, refrigerating plants and hotels continue longer hours, and the load factors are based on their actual running conditions. The load factors for any business that normally runs only an approximate fifty-four-hour week would not apply should any industry in this class run two shifts of men or run a night shift occasionally. Any increase in the hours' use of the current in this way would tend to better their load factor.

The figures include both power and light, and are on the larger class of customers, and in the majority of cases mentioned the power predominates to a large extent, the light having a comparatively small effect on the load factor. These figures are based on the yearly load factor. Some months the load factors are better than in others, but the figures given are an average.

LOAD FACTORS OF SMALL AND MEDIUM LIGHTING CUSTOMERS.

Kind of Business.	Number of Customers.	50-Watt Equivalent.	Monthly Kilowatt Hours.	Total Kilowatt Maximum.	Load Factor.	Ratio of Maximum to Connected Load.
Amusements	245	32,592	100,265	904	15.2	56.3
Automobile garages	204	7,596	20,524	228	12.4	60.5
Banks	100	9,102	35,334	304	16.1	66.8
Barns	542	7,068	17,872	242	10.2	68.5
Baths	17	380	1,086	12	11.8	66.9
Breweries	36	3,314	7,085	74	13.2	44.8
Building owners	147	8,324	39,120	209	26.5	50.3
Buildings (public)	18	3,152	6,750	53	17.6	33.6
Churches	15	3,301	8,274	92	12.4	56.0
Clubs	65	12,071	16,988	244	9.6	28.8
Commission houses	238	4,996	20,164	172	16.2	68.9
Contractors	53	3,327	16,489	99	22.9	59.8
Express companies (small)	89	4,073	14,250	90	21.9	44.3
Flats	24,177	328,939	443,530	8,927	6.9	54.1
Florists	129	3,295	12,205	1,184	10.1	71.8
Foundries and rolling mills	104	6,679	10,939	184	8.2	55.1
Halls, apartment buildings	2,473	9,915	62,863	616	14.2	90.0
Halls (public)	193	14,136	24,317	486	6.9	68.6
Hay, grain, feed and coal	112	2,081	3,888	81	6.7	77.6
Hospitals	34	3,290	6,248	69	12.5	42.3
Hotels	103	9,072	22,443	127	24.4	28.0
Houses	5,151	189,616	229,753	4,076	7.8	43.0
Laundries	42	651	1,647	22	10.3	67.5
Loan firms	35	1,033	3,113	32	13.3	62.8
Manufacturers	1,061	52,129	94,842	1,397	9.5	53.5
Meat markets	325	5,089	12,346	187	9.1	73.5
Milk depots	52	1,192	4,050	37	14.9	63.0
Monuments	4	323	1,215	100	16.4	63.5
Offices (business)	3,704	77,230	163,657	2,482	9.2	64.2
Offices (professional)	1,563	25,529	39,736	817	6.7	64.0
Photographers	159	4,393	6,483	170	5.3	77.6
Pool and billiards	97	2,711	11,007	87	17.4	64.5
Printers and engravers	381	14,680	45,872	433	14.7	59.0
Publishers	94	5,110	9,104	155	8.1	60.8
Railroad business	105	8,510	41,504	320	17.9	75.0
Restaurants	550	20,846	92,308	547	23.4	52.3
Saloons	2,060	50,002	234,711	157	20.8	62.6
Schools	78	5,515	7,639	148	7.2	52.9
Second-hand dealers	47	1,646	2,866	36	11.0	44.0
Shops (bakery)	251	3,746	12,684	133	13.1	71.3
Shops (barber)	443	4,883	14,214	172	11.5	70.4
Shops (bicycle and electrical)	62	761	1,309	23	7.7	61.9
Stores (bird)	2	89	477	3	19.0	78.8
Shops (blacksmith)	109	1,840	2,190	611	5.0	66.5
Shops (carpenter)	58	970	1,135	27	5.8	55.5
Shops (harness)	5	54	98	2	7.5	67.8
Shops (machine)	125	5,715	6,654	106	8.7	37.2
Shops (paint)	107	4,222	8,739	105	12.1	49.8
Shops (plumbing)	39	734	1,090	16	8.9	46.0
Shops (tailor)	552	16,796	30,462	498	8.4	59.3
Small hotels and rooming houses	66	2,022	12,817	684	26.0	67.4
Social settlements	21	3,037	6,140	79	10.7	52.5
Stables (livery)	103	2,612	10,862	68	22.2	52.3
Stores (art)	91	2,203	5,497	75	10.2	68.5
Stores (book and stationery)	80	2,615	7,052	87	11.7	66.4
Stores (cigar)	226	5,562	21,924	180	16.8	64.7
Stores (cleaners and dyers)	133	3,373	5,409	94	8.0	56.3
Stores (clothing)	204	14,293	22,096	378	6.6	52.9
Stores (coffee)	127	2,115	5,169	78	9.1	74.5
Stores (confectionery)	322	6,422	17,193	197	12.5	61.5
Stores (crockery)	19	1,170	1,590	30	7.2	52.4
Stores (drug)	833	17,018	92,809	671	19.3	78.8
Stores (dry goods)	367	11,835	26,774	453	8.2	76.5
Stores (furniture)	225	18,741	28,105	654	6.0	69.7
Stores (gentlemen's furnishing)	157	5,270	15,322	183	11.6	69.3
Stores (grocery)	434	6,576	17,985	240	10.3	73.0
Stores (hardware)	159	7,925	12,182	158	10.6	40.0
Stores (hat)	41	1,662	5,371	54	14.5	65.0
Stores (house furnishing)	8	279	409	7	7.8	52.0
Stores (jewelry)	316	8,813	30,424	283	15.0	64.1
Stores (millinery and dressmaking)	280	9,982	31,793	348	12.7	69.7
Stores (music)	41	1,677	3,664	40	12.4	48.8
Stores (piano)	33	4,260	10,241	108	13.0	51.1
Stores (shoe)	307	6,499	15,172	216	9.8	66.5
Stores (small)	49	3,069	6,293	127	6.8	83.1
Supply houses	372	18,815	49,668	556	12.4	58.8
Telephone companies	15	363	2,592	12	29.0	67.0
Theatres	18	8,264	24,994	200	17.2	49.0
Tunnel companies	6	584	2,284	12	27.0	40.5
Undertakers	103	2,381	4,618	69	9.3	57.9
Warehouses	109	6,686	12,020	138	12.0	41.4
Wholesale houses	201	17,113	55,740	401	19.4	46.6
Wines and liquors	45	1,919	7,214	63	16.0	65.5
Wrecking companies	2	139	917	5	21.2	76.8

Kind of Business.	Load Factor, 8,760-Hour Year, Per Cent.	Ratio of Actual Max. to Connected Load, Per Cent.	Hours' Use per Day of Max. 365-Day Year.
Butter and creamery	20	60	4.8
Breweries	45	60	10.8
Brass and iron beds	20	60	4.8
Biscuit manufacturers	35	55	8.4
Boots and shoes	25	65	6.0
Brass manufacturing	28	50	6.7
Boiler shops	18	45	4.3
Can manufacturers	30	70	7.2
Candy manufacturers	18	45	4.3
Clothing manufacturing	15	55	3.6
Clubs (large)	40	85	9.6
Department stores (large)	30	55	7.2
Electrical Manufacturing	25	55	5.5
Express companies	40	60	9.6
Electroplating	25	75	6.0
Engraving and printing	19	60	4.6
Fertilizer manufacturing	75	40	18.0
Furniture manufacturing	28	65	6.7
Foundries	15	75	3.6
Forge shops	30	49	7.2
Grain elevators	10	75	2.4
Glove manufacturing	25	55	6.0
Grocers (wholesale)	20	55	4.8
Hotels (small)	35	50	8.4
Hotels (large)	50	40	12.0
Ice-cream manufacturing (large)	45	75	10.8
Jewelry manufacturing	18	50	4.3
Large restaurants	50	60	12.0
Laundries	25	70	6.0
Machine shops	26	55	6.2

Newspapers	20	75	4.8
Packing houses	30	75	7.2
Paint, lead and ink manufacturers	23	45	5.5
Paper-box manufacturers	25	50	6.0
Plumbing and pipe fitting	26	55	6.2
Pneumatic tube	50	90	12.0
Post offices	50	30	12.0
Power buildings	27	40	6.5
Refrigeration	50	90	12.0
Railroad depots	50	50	12.0
Saw manufacturers	30	55	4.8
Seed cleaners	25	55	6.0
Screw manufacturers	30	75	7.2
Sheet-metal manufacturers	18	70	4.3
Small restaurants	30	70	7.2
Soap manufacturers	25	60	6.0
Spice mills	20	55	4.8
Stone cutters	17	55	4.2
Structural steel	22	40	5.3
Textile mills	20	65	4.8
Theatres	16	60	3.8
Twine mills	30	60	7.2
Woolen mills	27	80	6.5
Woodworking	28	65	6.7

The load factors in this table may vary somewhat in different parts of the country, due to the difference in the time of sunset. This, however, would not seriously affect the load factor of the power end of the business, but would apply largely to the lighting. However, adjustment of this difference can be made without much trouble by a little study of the local conditions.

Tests taken by curve-drawing instruments or by the reading of the wattmeters in a given plant during five-minute intervals all day indicate a wide variation in the load conditions on almost all manufacturing plants. Maximum load conditions in factories in Chicago seem to be between 4:30 and 5 p. m., regardless of the time of the year. The maximum load conditions in these industrial plants do not, therefore, come at the time of the peak conditions of the central station. This applies only to plants using power and very little light. There is a point of maximum in these plants at the time of the central-station peak, but generally speaking it is not the highest maximum of the customer. This falling off of the factory load before the time of the central-station peak is one of the reasons why the central-station company is enabled to carry much more business that it would reasonably seem able to. This difference in the time of the maximum of different classes of business makes what is known as the diversity factor.

Large central-station plants are usually capable of taking care of motor and lighting customers having a combined connected load of from two to three times greater than the maximum generating capacity of such a plant. This is demonstrated by the fact that the load factor of large central stations is from thirty to forty per cent, while in the average industrial plant the load factor rarely exceeds twenty-five per cent.

In referring to the load-factor table heretofore mentioned, you will notice considerable variation in the figures. If a central-station company were to secure all of the business in a given city, the diversity factor of all of these customers would be such that the load factor on the station would probably be in the neighborhood of fifty per cent. As in some of the best central stations the load factor at present is in the neighborhood of forty per cent, some may question the possibility of raising this condition to fifty per cent; but if we consider that the time of travel on surface lines and elevated trains is necessarily after the time of the peak, and that the time of travel on suburban steam trains is fully a half hour later; further, that in large centers there is a large amount of summer business, such as amusement parks and large refrigerating plants, and that the time of the house-lighting peak is later in the evening, we can reasonably hope that in the future our load factor will be considerably better as we secure more business.

Even with so good a load factor as fifty per cent, we still have a long way to go before we obtain the ideal in central-station conditions. It seems necessary, therefore, that central-station companies must look to the improvement of their load factors by encouraging the making of by-products from electrical energy; products that could be used in large quantities, such as ice and nitrates.

There has been some discussion as to the advisability of selling power off the peak of the central station. This would be a dangerous thing in a large center where it is nearly impossible to control the situation. If a number of contracts were made with customers off the peak, and they, for some reason, used the energy on the peak, I am afraid the central station would have considerable trouble in adjusting the matter. In a small town it is very easy to watch the few large customers and see that they keep to their agreements. In any small town, where the amount of power used is small, it might be a reasonable proposition to sell the power in this way to advantage.

Any business a central station can get during the summer months should not be strictly considered as off-peak business in the ordinary meaning of the term, and as the time of this load is easily controlled this business should be sought after by all central-station commercial men.

I should like to point out the great value of the collecting of load factors on different industries by the different companies belonging to the Association. It would help the commercial department of the different companies immeasurably if such information were available. No true analysis can be made of current consumption by different customers unless this information is at hand, and if we expect our commercial men to handle larger customers intelligently, we must place in their hands the necessary information. The selling of electricity in larger quantities is becoming common, and we find it becomes more necessary every day to have the men in the commercial department properly educated on every point in connection with the obtaining of this larger business.

In closing, I will say that there seems to be some difference of opinion as to the exact meaning of the term "load factor." The American Institute of Electrical Engineers' Standardization Rules say the "load factor" is the "ratio of the average load to the maximum load." This term ought to be more closely defined. The term "maximum load factor" might mean the ratio of average kilowatts to maximum kilowatts. The term "capacity load factor" might mean the ratio of average load to capacity of the plant, the "connected load factor" the ratio of average kilowatts delivered to connected kilowatts. It might also be stated that there is some misunderstanding as to the term "maximum demand;" whether the load factor is figured on momentary, one-minute, fifteen-minute, or one-hour peaks; whether the absolute or momentary maximum be used or the average maximum be used in determining the load factor. By applying these different conditions you might have many different kinds of load factors, such as momentary or absolute maximum load factor, average maximum load factor to be made up of the average of momentary peak loads, five-minute load factors, half-hour maximum load factors, etc.

Of course, it is understood that all of these load factors would be on the yearly basis, as the monthly load factor might vary considerably from the yearly load factor; for instance, in the case of the refrigerating plant, where in the North for seven months in the year the plant runs at a load factor of, say, seventy-five per cent, whereas in the winter time the load factor probably does not exceed thirty per cent.

It seems to me that it would be a good idea for all interested to get together and adopt a fixed scale of definitions of load factors, in order that there might be no misunderstanding of the meaning when discussing the term.

THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

TOLEDO, OHIO, JULY 21, 22, 23.

The ninth annual convention of the National Electrical Contractors' Association bids fair to be one of the largest and most successful ever held by this progressive organization. The convention will be held July 21, 22 and 23, at Toledo, Ohio, hotel headquarters being established at the Boody House, the meetings being held in the Chamber of Commerce rooms. Arrangements have been perfected for vigorous addresses at the executive sessions, and there will also be a number of important papers at the open sessions

The entertainment committee has arranged for a number of special events, including a men's banquet, a ladies' banquet, an all-day outing and a ladies' trolley ride. The following programme has been arranged:

WEDNESDAY, JULY 21.

10 a. m.—Open session, Chamber of Commerce rooms.

2 p. m.—Business session, Chamber of Commerce rooms.

THURSDAY, JULY 22.

10 a. m.—Open meeting, Chamber of Commerce rooms.

10:30 a. m.—Ladies' trolley ride.

2 p. m.—Business meeting.

8 p. m.—Men's banquet, Boody House banquet hall.

8 p. m.—Ladies' banquet, Boody House parlor.

FRIDAY, JULY 23.

All-day outing at Sugar Island. Excursion leaves Toledo at 9 a. m., and returning leaves the island at 5:30 p. m.

The ladies' trolley ride will be one of the features of the entertainment covering a trip up and down the Maumee Valley with luncheon at the Beach.

At the outing on Friday there will be a baseball game between eastern and western contractors, captained, respectively, by James R. Strong, of New York, and E. McCleary, of Detroit.

The National Electrical Contractors' Association was organized in Buffalo in 1901, the first steps toward the organization being taken in New York about 1898. The New York state contractors had organized in 1896, and their organization had grown in numbers and in prestige so that the benefit of solidarity in taking up many of the questions which perplexed the contractors indicated the value of a national organization. In 1901 the New York state association appropriated the necessary money and called a convention at Buffalo. As many contractors as could be reached were notified, and when the first session was called nearly 200 electrical contracting companies were represented. Plans were not completed at the first meeting, but the organization started off with thirty-one members, from which time there has been a steady and continuous growth.

The object of the organization is to improve the conditions of the contracting trade throughout the country. The business of the electrical contractor has become well recognized, and it is realized that upon the ability and integrity of the contractor lies the successful outcome of nearly every installation of any importance throughout the country.

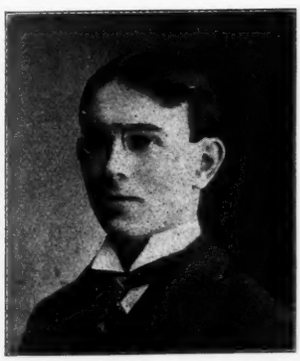
The organization has exerted a powerful influence in securing the proper recognition of wiring rules and inspection laws, and has worked with the Underwriters' Association in securing proper interpretations and making effective the rules of the National Electrical Code.

In July, 1902, a committee was appointed from the organization to take up the question of wiring rules and inspection work, and allowed the privilege of the floor at the Underwriters' meeting. In January, 1903, the association obtained membership in the National Conference on Standard Wiring Rules.

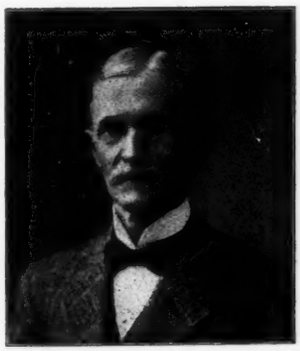
Important work has also been done by the organization committees in bringing about satisfactory conditions between labor organizations and employing contractors, and also in the matter of licensing contractors and securing uniform laws, and bringing order out of chaos caused by conflicting ideas and requirements in various cities throughout the country.

One of the most important efforts of the organization has been the adoption of a standard set of symbols for marking electrical work on plans. These symbols cover the subject thoroughly and have been adopted by the American Institute of Architects and several departments of the United States government.

G. M. Sanborn, Indianapolis, President.



C. R. Kreider, Chicago, Second Vice-President.



John R. Galloway, Washington, Treasurer.

W. H. Morton, Utica, N. Y., Secretary.

OFFICERS OF THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

The officers of the organization are as follows:

President, G. M. Sanborn, Indianapolis, Ind.

First vice-president, M. L. Barnes, Troy, N. Y.

Second vice-president, Charles R. Kreider, Chicago, Ill.

Third vice-president, H. S. Potter, Boston, Mass.

Treasurer, John R. Galloway, Washingington, D. C.

Secretary, W. H. Morton, Utica, N. Y.

Sergeant-at-Arms, J. C. Stearns, Buffalo, N. Y.

The directors are as follows: Arkansas, C. J. Drees, Little Rock; Illinois, J. T. Marron, Rock Island; Indiana, F. H. Cheyne, Indianapolis; Iowa, Edward Kunkle, Davenport; Massachusetts, Seth B. Wetherbee, Boston; Michigan, J. J. Thorne, Bay City; Minnesota, William Burgess, Duluth; Missouri, Charles J.

Sutter, St. Louis; New Jersey, Paul H. Jaehnig, Newark; New York, James R. Strong, New York city; M. L. Barnes, Troy; James Hilton, Syracuse; Ohio, M. W. Hansen, Toledo; Pennsylvania, W. I. Patterson, Pittsburg; Texas, J. M. Walshe, Texarkana.

To Celebrate Tunnel Opening.

Celebration of the opening of the McAdoo twin tunnel tubes from Cortlandt Street, New York, to Exchange Place, Jersey City, will take place on Monday next. The official train is scheduled to leave the Hudson Terminal Building at 10:15 a. m. The moment it starts Jerseyward a message will be telephoned to Assemblyman Charles Hendrickson, Jr., who will be in the office of General Superintendent Frank L. Sheppard, of the Pennsylvania Railroad, and he will give the signal for the explosion of twenty bombs high above the big train shed. Then the engineers of all railroad locomotives and river craft are expected to toot their whistles.

A special committee will meet the tunnel day guests at the station and escort them in automobiles to a grandstand in front of the City Hall, where addresses will be made. It is expected that Vice-President Sherman, Governor Fort, of New Jersey; William McAdoo, president of the tunnel company; President McGowan, of the New York Board of Aldermen; Mayor Wittpenn, of Jersey City, and others will speak. A band concert will precede the oratory. The speakers and other guests will return to New York city for dinner.

Band concerts will take place at the new West Side County Park at 3 and 7:30 p. m. and a fireworks exhibition will be given in the park from 8:30 to 10:30 o'clock.

Public Service Commission to Advertise for Subway Bids.

The New York City Board of Estimate approved on July 2 the report of its special subway committee to grant the request of the Public Service Commission for permission to advertise for bids on all the subway plans now before it.

When the action of the board was reported to Chairman Willcox of the commission he said that the preparation of contracts and the forms of bids will be started at once. The individual bids and offers on the plans already submitted will come before the board again when they are presented.

The New Haven Road Sells Its Street Railroad Securities.

Over his own signature, President Mellen, of the New York, New Haven & Hartford Railroad Company, informs the State Board of Railroad Commissioners that his company has disposed of its interests in street railways in Massachusetts.

This is in effect a report that the company has complied with the decree of the Supreme Court of Massachusetts that on or before July 1, 1909, it must part with all its holdings in the Worcester & Southbridge, Worcester & Blackstone Valley, Worcester & Webster, Worcester & Dudley, the Berkshire and the Springfield Street Railway companies, and such other street railway interests as it may hold in Massachusetts.

Under the date of New York, July 1, 1909, President Mellen wrote to Charles E. Mann, clerk of the Massachusetts Board, as follows:

"This company is neither directly nor indirectly concerned in the control of any street railways in the commonwealth of Massachusetts."

That something must have happened since February 15 of the present year to change the relation between the New Haven company to some of the street railway interests of the state, forming the basis for the above statement, is to be assumed from the fact that on that date the New Haven company sent to the Legislature a long report admitting that at that time it had not fully dispossessed itself of street railway holdings in Massachusetts. By order of its board of directors the statement made then contained the following:

"All the shares of the New England Investment and Securities Company held by the New England Navigation Company have been sold to individuals for cash at the same price which the said company paid for them.

"With the exception of its interests in securities of the Worcester & Webster and Worcester & Dudley Street Railway companies and the interest of the Rhode Island Company in earnings and indebtedness of Interstate Consolidated Street Railway Company, above referred to, the New York, New Haven & Hartford Railroad Company has not now any interest, direct or indirect, in any of the bonds, stock or indebtedness of any street railway company organized under the laws of Massachusetts."

This report that the company has sold its holdings in Massachusetts, in compliance with the Supreme Court decree, was brought out in correspondence over another matter. President Mellen was asked by the Railroad Commission what companies carry express goods over his lines in Massachusetts and he availed himself of this opportunity to have entered on the records of the board a statement that he has complied with the court decree.

Pennsylvania Railroad Completes Bergen Hill Tunnel.

The Pennsylvania Railroad has completed the construction of its tunnels under Bergen Hill and the Hudson River into its station at Seventh Avenue and Thirty-third Street, New York city.

The Hackensack portal is located 6.1 miles from the junction with the main line at Harrison, just east of Newark, N. J. A temporary track has been installed on the embankment from Harrison to the portal, and materials for the track laying will be carried over this line and into the tunnels.

Thus culminates the construction work on the first two tunnels to be built for trunk-line service under the Hudson River. The first excavation was begun May 12, 1906. The north tunnel was joined on September 12, 1906, and the south tunnel on October 9, 1906. The tunnels under Bergen Hill were connected on May 7, 1908, and April 11, 1908, respectively.

These two tunnels, which are twenty-three feet in exterior diameter, are lined with two feet of concrete and therefore are of nineteen feet interior diameter. They extend from the Hackensack portal under Bergen Hill to Weehawken shaft, a distance of 1.2 miles, and from the latter to Ninth Avenue, New York, 1.4 miles.

The tunnels contain 64,265 tons of cast-iron and steel, while in addition 740 tons of structural steel were used. In bolting the segments together, 2,606 tons of steel bolts were utilized. In the various concrete linings 240,500 barrels of cement were consumed and 170,400 cubic yards of concrete were installed. In addition, there were 4,980 cubic yards of brick work, and in the benches alongside of the tracks 1,827,396 duct feet, or 346.1 miles of conduits were installed.

An Electric Weighing Machine.

A trial electric weighing machine has been built at the Philadelphia Mint from the designs of Frank Davis, a Government employe. It is intended for use by the customs weighers and inspectors for the weighing of imported raw sugar.

QUESTIONS AND ANSWERS.

DETERMINATION OF MOTOR SPEED.—How is the speed of a motor predetermined, that is, in winding two shunt motors for 110 volts, one to run at 800 and the other at 1,200 revolutions per minute, each motor being rated at ten horsepower? —M. A. L., Peoria, Ill.

The speed of a shunt motor is dependent upon the details of its entire design. In the following equation is given a formula that shows the relation of the speed to the main elements of the machine:

$$n = \frac{(E - I_a R_a)\, c\, 10^8}{M\, p\, N}$$, where E

is the impressed electromotive-force, R_a the resistance of the armature, I_a the current through it, c the number of parallel circuits for the current through the armature, M the magnetic flux (number of lines of force) per pole, p the number of poles, N the number of armature conductors, and n the speed in revolutions per second. From this it can be seen that the first thing to be determined is the armature current and approximate resistance, knowing which and the general design of the armature as to the number of circuits and of the field as to the number of poles and the flux per pole, the number of armature conductors N can be determined by solving the above equation for this factor. In the two machines cited, even though they be of the same output, the field construction may not be identical, so that the number of conductors on the armature is not the only variable element in the problem. In a simplified case, however, where the field structures of the two machines were identical, the only factors that would be variable would be N and R_a.

OPERATION OF TRANSFORMERS IN PARALLEL.—Is it good practice to operate distributing transformers in parallel with each other? It has been recommended to us by some and considered inadvisable by others.—G. T. E., Dallas, Texas.

The operation of transformers in parallel has the advantage of equalizing the load, giving thereby a better service per kilowatt of installed capacity. The disadvantages, however, are quite serious and generally outweigh this desired feature. If one of two transformers should become overloaded so that its fuse blows, the other transformer will have to carry the entire load, which probably will cause its fuse to blow also, thus cutting off the service of a larger district than if the trouble were confined to but one transformer. It makes it difficult also to locate where the original trouble developed. Cases have occurred in which, where two transformers were operating in parallel within a few blocks of each other, after replacing the fuse on one transformer, the lineman would find that before he had time to replace that on the other the one he had just worked on would have its fuse blown again. This is evidently because all of the load was thrown upon that transformer. Where the two transformers are operating very close together and preferably upon the same installation, the parallel grouping is desirable when there is not on hand a single transformer that is large enough to carry the combined load. But in general when the transformers are scattered it is rather a poor plan to attempt to operate them in parallel.

LIGHTNING RODS.—In a recent violent storm the chimney of our plant, which is about sixty feet high, was struck by lightning, and a considerable portion of the coping was demolished. This chimney has a lightning rod, which seems to be intact and in good order. Why did it not protect the chimney?—S. N., Louisville, Ky.

In order that the lightning rod be effective in protecting any structure upon which it is erected it must be intact and in perfect working order throughout. In the case in question the lightning rod probably was in good repair as far as casual examination could disclose. In all likelihood, however, there was either a poor ground connection or the upper extremity of the lightning rod had become badly corroded by the smoke and fumes from the chimney. The latter was probably the source of trouble. To guard against this, it is necessary that the upper extremity of the rod be provided with a number of points made of non-corrosive metal of good electrical conductivity. On large chimneys it has been considered necessary to use eight or more points of platinum-coated copper, which, however, makes an expensive installation. Attention should be given to the ground connection to insure that the rod terminates in a ground plate or pipe which is deeply embedded in moist earth. Addition of salt in the vicinity of the ground plate has been found effective in drawing and holding the moisture. On the whole, it is absolutely necessary to make the lightning rod have as perfect conductivity from its extreme point to its connection with the earth and to have it follow as direct a path as possible.

PLANTE AND FAURE STORAGE BATTERIES.—What is meant by Planté and Faure storage batteries? Are these trade names or are they different classes of batteries?—J. M. S., Cleveland, Ohio.

The names Planté and Faure refer to the two principal classes of the commercial lead storage battery. The distinction lies in the manner of plate construction. In the Planté type plates of pure lead, after being mechanically prepared to give them a large surface, are electrochemically treated to change this surface to either of the active materials, lead peroxide or spongy lead. In the Faure type the plates are made by filling into a grid, which is usually of antimonious lead, a paste composed of oxides of lead with dilute sulphuric acid. This latter construction is very much cheaper and is used principally for storage batteries that are subjected to such violent service that their life is comparatively low, so that it is desirable to keep the original cost of plates and of plate renewals to a minimum. Therefore practically all electric-vehicle batteries are now made of the Faure or pasted type. The Planté type is used chiefly for batteries where long life is desired and where space and weight limitations are not so important. For example, in stationary batteries, the Planté or electrochemical plates are chiefly used. In quite a number of batteries it is coming to be the practice to use the Planté positive with pasted negative plates, since the life of positives is less than that of negatives in general, and the life of Planté plates is considerably greater than that of the pasted ones. The names Planté and Faure are derived from two Frenchmen who developed the two types which now bear their name.

X-RAYS ON ALTERNATING-CURRENT CIRCUITS.—Why is it that X-ray coils are not used on alternating-current circuits? How could the coils be connected to work with alternating current?—L. M., Chicago.

The X-ray tube is essentially a direct-current apparatus. This is evident from the fact that X-rays are frequently called cathode rays. With an ordinary induction coil operated by a battery the electromotive-force induced in the secondary on making the circuit is much less than that on breaking it; furthermore, the X-ray tube itself has a tendency to oppose the flow of current through it in any but the right direction. If strong enough current is applied in the opposite direction, the tube is apt to be injuriously affected. Therefore, if such a tube is to be used with alternating current, a rectifier outfit or motor-generator must be used, the induction coil being connected on the direct-current side.

Denver Gas and Electric Company Reorganization.

Vice-President and General Manager Frank W. Frueauff, of the Denver Gas and Electric Company, has arranged for a reorganization of the company. He confirms the already published statement that there will be a $25,000,000 bond issue this fall for the purpose of taking all the underlying and subsidiary companies of the Denver Gas and Electric Company into the new corporation. These underlying companies include the Lacombe Lighting Company, the Denver Highlands Electric Company, and the Denver Consolidated Gas Company.

Prior to the reorganization, lien bonds of the Denver Gas and Electric Company to the amount of $452,000 will be called in.

Reorganization plans also include an increase in capital stock from $3,500,000 to $10,000,000, and a stock dividend which will give shareholders in the present company about three-and-one-third shares in the new company for their old stock.

The first use of the new bonds, which will be secured by a general mortgage and all the rights and properties of the company, will be used to retire such former bond issues as can be legally accomplished.

There are outstanding now $250,000 of seven per cent interest notes, due in 1910; prior lien bonds of the Denver Gas and Electric Company amounting to $458,000, bearing six per cent, and due in 1918; Denver Consolidated Gas bonds amounting to $936,600, bearing six per cent, and due in 1911; general mortgage bonds amounting to $5,691,000, bearing five per cent interest and due in 1849.

The 1911 bonds cannot be called until due.

A portion of the new bond issue will also be set aside to carry forward about $2,500,000 worth of improvements and extensions.

St. Paul Electrification Plans.

The Chicago, Milwaukee & St. Paul, it is learned, has temporarily given up its plan to electrify fifty miles of its Pacific Coast extension, including the tunnel through the mountains.

It has been found that one of the waterpower stations proposed by the road would not be sufficient to supply power the year around, and the management does not care at this time to undertake the construction of two waterpower plants. Later on, it is expected, the use of electric power will be resorted to in order to increase the efficiency of the mountain section of the line.

An Interesting Freight Classification and Rate Decision.

The Interstate Commerce Commission at Washington, D. C., has handed down its decision in the complaint of the Otis Elevator Company against the New York Central & Hudson River Railroad Company and others, which was filed on December 1, 1908, but also involved a complaint offered informally to the Commission in 1907. In the last case the company shipped from Yonkers, N. Y., to San Francisco, Cal., a carload of electrical hoisting machinery and elevator controllers, weighing an aggregate of 35,500 pounds. The originating carrier was the New York Central & Hudson River Railroad Company and the delivering line the Atchison, Topeka & Santa Fe Railway. The initial carrier billed the entire shipment under Class A at a rate of $1.40 per hundred pounds, but when the shipment arrived at its destination the delivering carrier compelled the complainant to pay a rate of $1.40 on the hoisting machinery, which weighed 33,250 pounds, and $3 per 100 pounds on the elevator controllers, which weighed 1,980 pounds, the latter being the first-class rate on less-than-carload shipments of electrical appliances and supplies not otherwise specified, and when shipped in boxes or barrels. The complainant alleged that the Class A rate of $1.40 per 100 pounds should have been applied also to the elevator controllers, as they were parts of the hoisting machinery and were shipped therewith, and reparation was asked for the difference.

The other case involved similar shipments, but in that case the hoisting machinery weighed 43,200 pounds and the elevator controllers 2,685 pounds. This shipment was delivered by the Southern Pacific.

The Atchison, Topeka & Santa Fe asserted that the lawful tariff rate was applied to the shipment, while the New York Central & Hudson River Railroad and the Southern Pacific agree that the elevator controllers were parts of the hoisting machinery and were entitled to the same rate.

Western Classification No. 41, effective October 1, 1906, and in force on the date of the shipment involved in the latter case, names Class A rate on hoisting machines, freight and passenger, s. u. or k. d., also parts thereof as named and parts, n. o. s., straight or mixed carloads, weight to be a minimum of 24,000 pounds. Western Classification No. 42, effective April 1, 1907, and under which the first shipment moved, carried the same provision. The classifications referred to on the dates of the respective shipments involved rated electrical controllers and parts thereof in carloads (subject to Rule 21-B), as Class A. Rule 21-B of the classification is as follows:

"The carload ratings shown in the classification for articles subject to Rule 21-B will not apply to straight carloads of the articles named. In such case the amounts of the articles so designated which may be included shall not exceed 33½ per cent of the minimum weight provided for the mixed carload."

These classifications at the time of said shipments rated electrical appliances and supplies in less than carloads, n. o. s., in boxes or barrels, as first class.

Rule 21-B applies to this case as far as the weight of the shipments is concerned if there is any provision for the mixing of hoisting machines with elevator controllers. It is the opinion of the Commission that the mixture was provided for in the provisions of Classifications 41 and 42, relating to the rating of hoisting machinery and parts thereof. The following provision is also found therein:

"Dynamos and motors forming an integral part of machinery may take the same rating as the machines of which they form a part."

The hoisting machinery comes under the general heading of machinery, and if dynamos and motors form an integral part of any kind of machinery, they certainly would form a part of electrical hoisting machinery. And if dynamos and motors form an integral part of electrical hoisting machinery it necessarily follows that electrical controllers are an integral part of hoisting machinery because they all have to do with generating, applying, and controlling the electrical current.

Therefore, the elevator controllers involved in these cases were part of the hoisting machines with which they were shipped, and under the classification could have been shipped in mixed carloads with elevators or hoisting machinery.

From the record it is the opinion of the Commission that the rate which should have applied to the total weight of each shipment was $1.40 per 100 pounds, and that, therefore, complainant is entitled to the reparation asked for with interest, and an order has been made.—A. F. T.

Physical Society of London.

At one of the June meetings of the Physical Society of London a number of interesting papers and discussions on electrical topics were presented. Among these was the paper by C. C. Paterson on the units of candlepower that are at present officially accepted in Great Britain, France, the United States and Germany. In this connection the author referred to the recent adoption of the international candle by the first three of these countries, which fact was noted in this journal some weeks ago. The principal discussion on this subject was by Doctor Fleming, who called attention to the fact that what was really required was an international primary standard of light instead of merely a unit, more or less arbitrary. Others who discussed the subject were Doctors Russell and Dyrsdale.

A paper on "Inductance and Resistance in Telephone and Other Circuits," by Dr. J. W. Nicholson, was presented. A number of formulas relating to this matter were presented by the author.

A paper by Doctor Russell and Arthur Wright, on "The Arthur Wright Electrical Device for Evaluating Formulas and Solving Equations," was then read. In this device special slide resistances are used. If R be the resistance of one of these, and a metallic finger make contact with it at a point where the scale reading is x, the resistance between this finger and the terminal of the slide is R/x. The scales of the slides are graduated logarithmically, as in the ordinary slide-rule, and the general manner of using the Wright device is similar to that employed in the slide-rule.

A British Electrical Industrial Association.

A meeting is to be held some time this month in London, at the instance of Sir W. H. Preece, to consider the formation of a society whose suggested name is "The Electrical Industrial Association of Great Britain." The Lord Mayor of London has consented to invite the banking and financial authorities to this meeting to consider the apparent want of confidence existing between capital and home electrical industry in Great Britain, and to suggest a remedy for this state of affairs.

In the course of a letter addressed to a small provisional committee of leading electrical manufacturers, Sir William Preece says: "We require an association which, supported by existing societies, will bring the public voice to bear upon their representations, so as to enable deputations to Government departments, and witnesses before Royal Commissions and Parliamentary Committees, to speak, not merely with the authority of experts, but with the force and weight of numbers from all sections of the industry. The association must in no way savor of the nature of a trade ring or of a trust. Its general constitution, embracing all sections of the industry in all parts of the country, insures this."

One of the causes of this agitation is that the German electrical firms, backed by German bankers, have successfully been competing of late with British firms which have had no bankers to back them in the same way. A German firm, for instance, has recently secured important contracts for the Victoria Falls scheme in Africa, in direct competition, of course, with British firms.

Government Takes Telephone Lines.

The telephone systems in the province of Saskatchewan, Canada, have passed out of the hands of private companies and will now be under the control of the province. The desirability of the public control of telephones has been so decidedly held in this new province that special governmental action was taken to oversee the situation and the officials chosen to do this were placed on an equal footing with those supervising railways—the result being that a department of railways and telephones has been in existence for some little time, and under its direction this absorption of the lines has been managed.

The price paid is understood to be favorable from the public viewpoint. The property includes 348 miles of long distance wires, four exchanges and thirty-one toll stations. There are only four cities in this new province, but there are thirty-nine towns and ninety-four villages, which, being scattered over an extensive area, depend greatly upon their telephone connections for sociability as well as for business arrangements.

The Telefunken System of Wireless Telegraphy.

In the issue of May 29 an article entitled "The New System of Wireless Telegraphy Used by the Telefunken Company," by Count Arco, was published as an original communication. Owing to a misunderstanding in the preparation and transmission of this article credit to the London *Electrician*, at whose expense the translation was made, was omitted.

Quebec's Light, Power and Traction Merger.

Rodolphe Forget, M. P., of Montreal, Can., has achieved another financial triumph. He has won out in his fight for the control of the Quebec Railway, Light and Power Company.

Now that the control of this corporation has passed into the hands of Mr. Forget, and those who gave them their support, financially, the work of refinancing and extending the entire system will be undertaken at once. It is the intention of the new syndicate to form a huge corporation by bringing about a gigantic merger of the street-railway, electric, gas and power interests throughout Quebec district, with a capital possibly of $8,000,000 or $10,000,000.

Following the acceptance of the resignations of the old directors, the important statement is made that at a meeting of the members of the new syndicate recently held at Quebec, the vacancies were immediately filled, by the election of W. G. Ross, Montreal, as president, with Frank Ross, Quebec, as vice-president, and the following directors: William Price, M. P., Quebec; J. N. Greenshields, K. C., Montreal; L. C. Marcoux, Quebec; N. Belleau, Quebec; Rodolphe Forget, M. P., Montreal; Frank Ross, Jr., Quebec, and Senator Robert Mackay, Montreal.

Ontario Government Finances Power Plan.

The Ontario Government is reported to have sold in London $4,000,000 four per cent bonds for the construction of its transmission lines and stations for the distribution of the power which is purchased from the Ontario Power Company of Niagara Falls under the contract of March, 1908. The construction of these transmission lines and stations is now proceeding by the hydroelectric commission.

A Department of Publicity for the Republic of Cuba.

With the beginning of the present fiscal year the Republic of Cuba established a Bureau of Information, President Gomez appointing Leon J. Canova, an American newspaper man, who has resided in Cuba eleven years and has a wide acquaintance with the island, as its director.

Parties wishing information of any nature concerning Cuba can obtain this free of charge by writing to Mr. Canova, Utility and Information Bureau, Department of Agriculture, Commerce and Labor, Havana, Cuba.

OHIO ELECTRIC LIGHT ASSOCIATION.

(*By Telegraph to the* ELECTRICAL REVIEW AND WESTERN ELECTRICIAN.)

TOLEDO, OHIO, JULY 13.—The fifteenth annual convention of the Ohio Electric Light Association was begun here at the well-known Boody House this morning. The attendance is very good, the programme excellent, the financial and general condition of the association better than ever, and the entertainment features much more elaborate than has been customary. All these elements give promise that this convention will be the largest and best that this, the strongest of the state electrical associations of the country, has ever held.

Shortly after 10 a. m. the first session was called to order by W. P. Engle, of the executive committee and past-president of the association. A communication from President C. R. McKay was read, in which he regretted that the removal of his business activities and residence to South Covington, Ky., enforced his absence from active participation in the convention, to which, however, he sent his greetings and sincere hopes for a very successful meeting.

Addresses of welcome to Toledo were made by Albion E. Lang, president of the Toledo Railways and Light Company, and the Hon. Brand Whitlock, mayor of Toledo. The report of the executive committee was read by W. F. Hubbell, of Wauseon, Ohio. Fifteen new members were recommended for admission. The report of D. L. Gaskill, of Greenville, Ohio, secretary-treasurer, was then presented. The finances of the association were never in better condition. By the publication of the souvenir programme by the association itself, instead of by contract, as hitherto, over $1,600 net profit was made through the liberal advertising of the associate members. Aside from this the net balance of the past year was over $400, twice that of the preceding year.

The paper on "Residence Lighting in Detroit," by F. T. Mather, of the Detroit Edison Illuminating Company, was read by the author. In it he described some features of the phenomenal success in this class of business met with in that city since the adoption of the low differential rate and liberal demand system. He also touched on the success achieved in supplying several suburbs of Detroit. In the discussion of this paper some of the speakers doubted whether business at such low rates could be made to pay except in a thickly populated community.

The afternoon session was called at 2 o'clock. Two important papers, entitled "The Supply of Electric Current to Other Towns From a Centrally Located Station," by O. H. Hutchings, of Dayton, Ohio, and Claude Smith, of Bradford, Ohio, were read by the secretary. These papers pointed out the excellent results secured to the generating and distributing companies and to the communities involved when a network of high-tension transmission lines is built from an economically operated central station to adjacent towns and villages. A spirited discussion of this subject followed, in which it was predicted that the small, poorly managed station is bound to disappear. Transmission networks are rapidly increasing. They enable a community of any small or moderate size, and even farmers, to be supplied with the blessings of electric service from a central plant that can be run efficiently for a greatly diversified load.

A paper on "Engine-Room Management" was read by F. R. Brosius, of Columbus, Ohio. The importance of making periodic inspections and tests of the equipment and of keeping adequate records of performances and repairs was strongly advocated by the author. After the discussion of several topics from the Question Box the session adjourned.

This afternoon automobiles were provided for giving the ladies attending the convention a ride to points of interest in this city. This evening a trolley trip to the Casino at the lake shore was followed by a banquet and theatre party. These entertainment features were much enjoyed by all who attended, which means practically all of the 200 persons now registered.

A detailed report of the convention proceedings will be given in next week's issue. F. H. B.

Collapse of Dam Deprives Southern Nevada of Power.

From Goldfield, Nev., comes the story of a poorly built dam, causing considerable loss to the power company as well as loss in wages to the men working in the mines. The deflecting dam of the light and power company on Bishop Creek, in California County, collapsed, forcing the suspension of the plant. Temporary repairs were effected, enabling the company to supply a limited amount of electricity for lighting purposes within twelve hours, but the mills and mines did not resume for forty-eight hours. Two thousand men were thrown out of work temporarily by the accident. The loss at the generating plant is estimated at $8,000.

Electrical Development in Porto Rico.

In a bulletin published by the Census Department there is a compilation of the electrical industries of Porto Rico covering the year 1907. It is the latest information obtainable as yet on this matter in Porto Rico. It covers all the electric public service companies, but does not include isolated electric or telephone plants connecting different rooms or departments of the same building and having no connection for communication with the public. The electrical enterprises of the island are not extensive as yet, but much promise is given for the future.

The total cost of plants comprising construction and equipment, not including the telegraph system, was $2,373,258, divided as follows: Street and electric railways, $1,971,512; central electric-light and power stations, $146,705; telephones, $255,041. The total income in 1907 was $663,031, and total expenses, including taxes and fixed charges, $497,124. The plants consisted of fifteen turbines of 3,825 horsepower, three waterwheels of 256 horsepower and twenty-five dynamos with a kilowatt capacity of 2,942. The equipment was all used by the railway, light and power companies.

There were three companies operating telephones in addition to those operated by the government insular system. Altogether there are 1,970 instruments and 1,651 miles of wire for the commercial telephone facilities of the island. There are 310 miles of pole line and 1,464 miles of single wire.

On the island are 469 arc lamps, 34,519 incandescent lamps, sixty-one motors. In regard to the use of electric current for light and power only six towns are lighted by electricity.

The electric railways are the most important branch of the electrical industries of Porto Rico. There were three street railways in operation and another under construction. The operation is on a small scale as yet, compared with the progress in the United States, but the density of population, which is greater there than in the majority of the states, warrants the belief that the increase during the current five years will be much greater than for the preceding period. The output in current of the electrical generators reported for 1907 was three times as great as for 1902.

Hudson-Fulton Aeronautics.

Former Assistant United States Attorney-General James M. Beck, chairman of the Aeronautics Committee of the Hudson-Fulton Celebration Commission, sailed for Europe July 7. When he finishes professional business which calls him abroad he will devote considerable time to meeting the leading aviators there with the idea of interesting them in the elaborate programme of aeronautics prepared as a feature of the celebration this fall and in getting in touch with the latest developments of aerial navigation. It is probable that international contests, irrespective of a contest arranged by a New York morning newspaper, will be held under the auspices of the Hudson-Fulton Celebration Commission.

The sum of $25,000 has been appropriated by the Hudson-Fulton Celebration Commission for aeronautics, and while the plans are not sufficiently completed for definite announcement, exhibitions and contests of great interest and educational advantage are assured. One of the most important features will be a series of spectacular flights and evolutions by aeroplanes, dirigible balloons and man-carrying war kites over and across the Hudson River during the progress of the great naval parade.

The Sign of the Times.

The West Penn Railways Company, of Connellsville, Pa., has erected a huge double electric sign on top of the Youghiogheny bridge. The sign reads: "West Penn, Light and Power, Cars Everywhere." The letters in "West Penn" are two feet high and the others eighteen inches. The sign can be read a long distance up or down stream. It will materially aid in lighting the bridge and adjoining territory.

The idea was originated by Superintendent J. W. Brown, and the work was designed by E. J. Mora of the illuminating department. The letters were manufactured and wired at the company's Greenwood shops. Nearly 600 electric bulbs are required to illuminate the seventy letters.

The Osiris Prize Award.

A despatch from Paris announces that the Osiris prize of $20,000, which is awarded once every three years by the Institute of France for the most remarkable achievement in sciences, arts, or industries, has been divided between Louis Blériot and Gabriel Voisin for their remarkable efforts in aviation.

Projected Big Telephone Merger.

Upon the outcome of a conference held at Parkersburg, W. Va., on July 10 last, depends a gigantic consolidation of the independent telephone companies of the entire United States. Representatives of Pennsylvania, West Virginia, Ohio, Indiana and Illinois independent telephone concerns are in conference looking toward the incorporation of the National Telephone Corporation of New York, with a capitalization of $100,000,000.

The news that a consolidation of the independents was pending is not entirely new. For months past there have been rumors that the local and Pennsylvania companies would soon reach some sort of an agreement and work in conjunction.

The conference adjourned until possibly the 16th in order to clear up a number of minor details. Up to the time of going to press no definite steps had been taken, but it is expected that it will be consummated before the end of the month.

Definition of Head of Water.

In a recent paper Charles T. Main, mill engineer and architect, of Boston, gives the following definition of "head" as applied in waterpower development, as follows:

There is the "legal head," or the head to which the owner has a right to develop his power. This may or may not have been developed to its full extent. It may be that the expense involved would be too great to warrant further development. In some cases it may be economy to make the expenditure necessary to get the benefit of some unused portion of the head.

The "gross head" is the head actually used for producing power and getting the water to and away from the wheel.

The "net effective head" is the gross head minus the loss in head required to get the water to and away from the wheel. This loss will vary with the length of the waterways leading to and away from the wheels, the velocity of the flowing water, and the construction of such waterways.

In several manufacturing cities where the waterpower is controlled by a company which is separate from the mill owners, there is an allowance of one foot made from the gross head before charging for the water as used on the wheels.

The head should be measured with the wheels running. The only portion of the head which produces power is the difference in level directly above and below the wheel when the wheel is running.

Connecticut River Power.

The new plant and dam of the Connecticut River Power Company, at Hinsdale and Lemon, Vt., will be formally opened in August. Already current is being supplied from it to places fifty-three miles away, to Fitchburg, Worcester, North Adams, Pittsfield, Springfield, Clinton, Winchendon and Gardner, Mass., and Lewiston and Manchester, Vt., as well as many smaller places for lighting, traction and factory purposes. It is considered the largest engineering project of its kind east of Niagara, and the cost has been several millions.

A miniature Niagara Falls has been constructed between Hinsdale and Vernon by means of the massive barrier of concrete thrown across the river there, where it is 900 feet wide. When the ten floodgates are shut the backed water forms a lake sixteen miles long at several points over a mile wide. The height of the construction above the river bed is thirty-four feet.

The two capitalists most prominently connected with the project are Henry L. Harriman, of Hyde Park, and Malcolm G. Chase, of Providence, R. I.

Specifications for Hard-Drawn Copper Wire.

At the 1909 meeting of the American Society for Testing Materials, held at Atlantic City, N. J., June 28 to July 3, Committee W, headed by J. A. Capp, of the General Electric Company, Schenectady, N. Y., brought in a well-drawn specification for hard-drawn copper wire, including round wire, grooved trolley wire, and cable made of hard-drawn wire. Its distinctive feature is the omission of twist or wrap tests and of all requirements as to elastic limit. The only mechanical requirements are for a tensile strength of from 49,000 to 67,000 pounds per square inch, according to the diameter, and for an elongation of from 0.7 to 2.7 per cent in ten inches. The only other requirements are for accuracy of size and for a conductivity given by a weight of from 900.8 to 910.2 pounds per mile-ohm. Cable must have a strength of at least ninety per cent of the sum of the strengths of its wires.

For An International Wireless Law.

International regulation of wireless telegraphy will receive prominent consideration at the fourth Pan-American conference, to be held at Buenos Aires, Argentina, July 9, 1910, if the tentative programme is approved.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

ELECTRIC PROPERTIES COMPANY.

The Electric Properties Company has issued its report for the fiscal year ended April 30, 1909, which compares as follows:

	1909.	1908.
Earnings	$231,188	$280,671
Salaries, legal exp., taxes, etc.	55,327	87,200
Net	$175,861	$193,471
Preferred dividends	135,669	179,344
Surplus for year	$ 40,192	$ 14,127
Previous surplus	49,574	35,447
Surplus April 30	$ 89,766	$ 49,574

At the annual meeting of the Electric Properties Company the following directors were elected for three years: Charles H. Allen, N. W. Halsey, Walter C. Kerr, C. Sidney Sheppard, R. B. Van Cortlandt, and George Westinghouse. Other directors were re-elected. The directors re-elected the officers.

NEW ORLEANS RAILWAY AND LIGHT.

Stockholders of the New Orleans Railway and Light Company have authorized an issue of $50,000,000 five per cent forty-year mortgage bonds. Of this sum $20,000,000 will be used immediately to retire outstanding notes.

INTERBOROUGH-METROPOLITAN BONDS.

In connection with the action of the Public Service Commission in deciding that it was not necessary for the Interborough-Metropolitan Company to get the Commission's permission to issue bonds to refund notes given by the company in the hard times of 1907, it was announced at the office of President Shonts, of the transit company, that J. P. Morgan & Company had bought the entire $10,000,000 issue of five per cent bonds with which to take up a similar amount of six per cent notes issued March 1, 1907, and due June 1, 1910, but callable at any time after June 1, this year.

It was said at the office of the Interborough company that the transaction merely enabled the company to reduce its interest charges one per cent on $10,000,000 for a year, as money was now cheaper than it was in 1907.

TOLEDO COMPANY AGAIN DEFAULTS.

The bondholders' committee of Toledo Railways and Light Company has sent a letter to holders of the first-mortgage four per cent consolidated bonds, in which they say that the company will not be able to pay the principal or interest on the $4,866,000 bonds maturing July 1. This will make the third default on interest payments, but the committee asks that no summary or drastic action be taken against the company because of these defaults.

Practically all of these bonds are deposited with the committee, which has agreed not to institute foreclosure proceedings.

FORT WAYNE & WABASH TRACTION.

The report of the Fort Wayne & Wabash Valley Traction Company for the month of May and five months ended May 31 compares as follows:

	1909.	1908.
May gross	$111,702	$107,190
Expenses	66,890	63,337
May net	$ 44,812	$ 43,853
Five months gross	532,676	505,166
Expenses	320,147	295,152
Five months net	$212,528	$210,014

INTERBOROUGH RAPID-TRANSIT BONDS.

J. P. Morgan & Company and Lee, Higginson & Company have sold the $10,000,000 Interborough Rapid Transit five per cent bonds. The bonds are part of the authorized issue of $55,000,000 approved last year by the Public Service Commission, of which $11,590,000, including the present offering, are outstanding and $28,108,900 pledged as security for the company's six per cent notes.

It is announced that the company has paid the special tax under Section 14 of the New York state tax law making these bonds tax exempt. The bonds are secured by the only mortgage on the Interborough's property, subject only to the city's rental. The net income, the company's statement shows, amounted last year to three times the interest on these bonds.

SCRANTON ELECTRIC COMPANY.

The Scranton Electric Company reports for the year ended April 30, 1909, as follows:

	1909.	1908.
Gross income	$501,061	$421,559
Expenses	254,918	236,745
Net income	$246,143	$184,814
Interest on bonds	77,600	75,000
Preferred dividends	30,000	30,000
Surplus for year	$138,543	$ 79,814

MEXICAN TELEPHONE.

The Mexican Telephone and Telegraph Company has issued a statement of earnings and expenses for the three months ended May 31, 1909, compared as follows:

March 1-May 31:	1909.	1908.
Gross earnings	$109,864	$ 93,194
Expenses, operating	38,712	37,706
Maintenance	13,271	13,776
Total	$ 51,983	$ 51,482
Net	57,881	41,712
Construction	43,098	20,812

INTERBOROUGH RAPID TRANSIT.

The Interborough Rapid Transit Company has issued a statement of income for twelve months ended May 31, 1909, as follows:

Gross earnings	$25,594,429
Operating expenses	10,799,650
Net earnings	$14,794,789
Other income	1,404,769
Gross income	$16,199,558
Rentals of subway and Manhattan Ry.	8,021,281
Taxes	1,786,520
Total rental and taxes	$ 9,807,801
Balance	6,391,757
Interest, charges, Interurban R. T. Co.	1,996,370
Balance	$ 4,395,387
Discount, etc.	19,185
Surplus for dividends	$ 4,376,202

The total outstanding funded debt of the company, including notes, is $35,014,000, on which there is an annual interest amounting to $1,984,940. In the period of twelve months ended May 31, 1909, the company earned $6,391,757 in excess of operating expenses, taxes and rentals, which is more than three times the annual interest upon its total outstanding funded debt.

A comparison of the company's gross earnings from operation during the last five years, follows:

Year ended:	
June 30, 1905*	$16,837,371
June 3, 1906	19,695,594
June 30, 1907	22,363,802
June 30, 1908	24,059,299
May 31, 1909	25,594,439

*The Subway was opened for operation in October, 1904, so that earnings for the year ending June 30, 1905, include only eight months' operation of the subway division.

LONDON UNDERGROUND.

The Underground Electric Railways of London report earnings for the week ended June 19 and for twenty-four weeks ended June 19, 1909, compared as follows:

	1909.	1908.
Bakerloo	£ 3,325	£ 3,010
Piccadilly	5,855	5,440
Hampstead	3,920	3,240
District	10,954	9,401
Tramways	6,859	7,413
Total	£ 30,913	£ 28,504
Twenty-four weeks:		
Bakerloo	£ 80,215	£ 73,165
Piccadilly	139,090	129,990
Hampstead	93,260	77,840
District	237,294	214,536
Tramways	138,217	149,637
Total	£688,076	£645,168

CENTRAL & SOUTH AMERICAN TELEGRAPH.

In reviewing the report of the Central & South American Telegraph Company for the quarter ended June 30, 1909, it will be noticed that the ratio of expenses to gross earnings for 1909 and similar periods of the three preceding years, gradually increased from over thirty per cent to about 44.5 per cent, while the percentage of net and other income to outstanding capital stock decreased from 3.26 per cent in 1906 and 3.46 per cent in 1907, to 2.6 per cent in 1908, and 2.11 per cent in 1909. These conditions are partially

due to the fact that expenses have been largely increased in the last four years by extensive alterations and repairs to the cables of the company and the laying of new lines. In addition, the company's "construction account," including the building of a transandine line in Argentina, has encroached heavily on the company's earnings.

The decrease in the percentage of net earnings to common stock for the company's second quarter may be accounted for in part by the reduction of through tolls to a uniform rate of $1 a word, between places on the west coast of South America and the United States and Europe. It is expected that the resulting natural increase in business will more than offset the loss in receipts.

The following table shows estimated earnings for the quarter ended June, 1909, compared with preceding years:

	1909.	1908.	1907.
Gross	$ 365,000	$ 408,000	$ 395,000
Expenses	163,000	162,000	132,000
Op. ratio, per cent	44.65	39.7	33.41
Net	$ 202,000	$ 246,000	$ 263,000
Other income	2,500	5,500	5,000
Total income	$ 204,500	$ 251,500	$ 268,000
Per cent on stock.	2.11	2.6	3.46
Dividends	143,565	143,565	144,855
Surplus	$ 60,935	$ 107,935	$ 123;145
Previous surplus.	1,495,492	1,172,712	2,024,181
Total surplus	$1,556,427	$1,280,647	$2,147,326

No new development work is planned, or under way, and in view of present conditions, dividend increases are hardly to be expected.

NORFOLK & PORTSMOUTH TRACTION.

The report of the Norfolk & Portsmouth Traction Company for the month of May and five months ended May 31 compares as follows:

	1909.	1908.
May gross	$151,599	*$152,175
Expenses	92,659	90,262
May net	$ 58,939	$ 61,913
Five months gross	759,016	*711,092
Expenses	450,221	448,912
Five months net	$308,795	$262,180

*Includes gross earnings of Norfolk County Ferries, which averaged about $17,000 per month. Ferry lease expired April 1, 1909, and assumed by other interests.

CUMBERLAND TELEPHONE AND TELEGRAPH.

The report of the Cumberland Telephone and Telegraph Company for the month of May and five months ended May 31 compares as follows:

	1909.	1908.
May gross	$ 524,954	$ 503,357
Expenses	268,557	292,790
May net	$ 256,397	$ 210,567
Charges and taxes	70,007	36,107
May surplus	$ 186,390	$ 174,460
Five months gross	2,643,848	2,552,614
Expenses	1,485,228	1,489,999
Five months net	$1,158,620	$1,062,615
Charges	243,179	187,635
Five months surplus	$ 915,441	$ 874,980

TWIN CITY RAPID TRANSIT.

The report of the Twin City Rapid Transit Company for the month of May and five months ended May 31, 1909, compares as follows:

	1909.	1908.
May gross	$ 569,217	$ 527,393
Expenses	260,970	254,577
May net	$ 308,248	$ 272,816
Chgs., taxes and pfd. divs.	140,251	126,972
May surplus	$ 167,996	$ 145,843
Five months gross	2,656,965	2,429,349
Expenses	1,361,601	1,265,571
Five months net	$1,295,364	$1,163,777
Chgs., taxes and pfd. divs.	687,507	621,178
Five months surplus	$ 607,857	$ 542,599

BOSTON ELEVATED.

The second installment of $30 per share on account of subscriptions to the $6,650,000 of new Boston Elevated stock has been paid. An additional five per cent of the stock was also paid in full at the same time, so that at present a fraction over twenty-five per cent of the entire issue has been paid in full. The next installment of $25 per share is payable October 18.

FRENCH WESTINGHOUSE.

The report of the Societe Anonyme Westinghouse for the year ended December 31, 1908, as read at the annual meeting held in Paris on June 15, shows profit and loss as follows:

	Francs.
Gross profit	1,686,254
Interest and proceeds from investments	94,510
Total	1,780,764
Administration expenses, taxes, etc.	290,221
Net profits	1,490,543
Interest on debentures and mortgage loan	683,642
Surplus	806,901
Brought forward from 1907	78,188
Total	885,089

The above surplus, frs. 885,089, was applied in the following manner:

Amortization on plants	530,955
Five per cent legal reserve	17,707
Dividend of 5 per cent on preferred shares	250,000
To carry forward	86,427
Total	885,089

The dividend is payable from September 1, subject to a reduction of four per cent for income tax and of transmissions tax upon bearer shares.

Since the close of the year under consideration the French Westinghouse Company has increased its capital from 15,000,000 francs to 20,000,000 francs. The proceeds of the issue of 5,000,000 francs of additional stock were used partly to pay off a mortgage loan of 4,000,000 francs.

Lexington Avenue Subway Plan Modified.

Acceding to the wishes of Lexington Avenue property owners, New York city, the New York Public Service Commission has modified the plan of construction for the Broadway-Lexington Avenue subway, so as to make under the avenue a double-deck instead of a single-deck tunnel.

The original plan adopted by the commission contemplated the placing of all four tracks on one level. Many property owners objected on account of the narrowness of the avenue and the resulting interference with abutting property. The commission therefore instructed its engineers to devise a better plan.

The engineers reported in favor of double-decking the road from Houston to One Hundred and Third Street, and from One Hundred and Thirteenth Street to the Harlem River. The commission has approved this modification, and so has the Board of Estimate.

The commission hopes that the property owners will now also consent, and has written asking them to do so. If consents are obtained from less than one-half, the consent of the Appellate Division must be sought, which will involve a long delay.

Cannot Tax Franchises.

Under a recent Supreme Court decision given in the state of Washington it was ruled that the counties in that state cannot tax a franchise given to the Western Union Telegraph Company. The treasurer of Pierce County had assessed the company's franchise at $15,000, and the company brought suit to prevent him from collecting a tax on this amount, with the result stated. The Supreme Court confirmed the ruling of the lower court from which the county had appealed.

Public Service Telephone Company.

Justice Blanchard, in the New York Supreme Court, denied the application made by counsel for the Public Service Telephone Company to vacate a stay granted on July 8 by Justice Blanchard in the suit of the Public Service Telephone Company for a writ of mandamus to compel the Empire City Subway Company to accord to it space in the ducts of the Empire City Subway Company for wires through Wall, William, Broad and New streets, New York city.

McCall Ferry Power Plan Extended.

The time for the deposit of stock and bonds of the McCall Ferry Power Company under the plan of reorganization announced to the security holders in May has been extended to July 21. It is announced that eighty per cent of the bonds and preferred stock have been deposited under the plan.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

WOOD PRESERVATIVES.

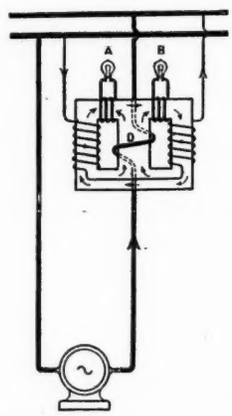
Preservatives of wood are always of topical interest to the electrical engineer, and consequently an account of some experiments on the subject, recently made in France, will be in order. The preservatives tested included carbonileum Avenarius, carbonileum Lyon, gas tar, microsol, lysol, antimony, antigermine, and hydrofluoric acid. It was found that for spruce, beech, poplar, oak, and Aleppo pine, exposed to the atmosphere, the best preservatives are certainly the carbonileums, gas tar, and microsol. The other substances examined produced absolutely no effect. These same preservatives (carbonileum, gas tar, and microsol) are also most efficacious for the preservation of wood in the confined hot air of mines. Antimony and hydrofluoric acid are less effective.—*Abstracted from the Scientific American, July 10.*

ELECTROLYTIC TINNING.

An electrolytic process, similar to galvanoplating, has recently been successfully introduced in Germany for depositing very heavy coatings of tin on articles of all sizes. The bath, which is kept at a temperature of between 120 and 140 degrees Fahrenheit, is heated by direct firing, by steam jets, or by a steam coil or double bottom, as desired. No stirring is necessary and the regeneration of the liquid is effected by anodes. For tinning small articles a perforated basketlike holder of sheet metal is most convenient. The bath is of enameled cast-iron, and may have a double bottom for steam heat if desired. The articles to be tinned are first to be cleaned from dirt, dust, scale, rust, soldering fluid, paint, etc. Those made of copper or of copper alloys are first cleaned with oxalic acid or its equivalent. Iron and steel articles, if rusty or covered with scale, are pickled in dilute sulphuric acid and scratch-brushed. Tumbling is recommended for such as will stand this process. If the articles are polished, turned, filed or stamped iron or steel, dull from long standing, or only slightly greasy, it is sufficient to tumble them in a five per cent soda solution for a considerable time. If they are very rusty or dirty it is well to wash them in ten per cent soda lye, then to pickle them in dilute sulphuric acid, then to rinse them in pure water, and finally to tumble them in weak lye and quartz sand. If a special polish is desired for iron or steel articles, they should be tumbled in a three per cent soda lye to which some soft soap has been added. After the cleaning process the articles should be rinsed in running water to remove any remaining pickle or other liquid. Articles of lead or zinc can be tinned at once after casting, without any special preparation. If, however, they have been exposed to the air for a considerable time they must be scratch-brushed. The articles are placed in a perfectly clean metal pan which is attached to the pole of the battery or dynamo. This pan, after being used two or three times, must be pickled in dilute nitric acid, and then thoroughly washed. The articles must not be piled on each other, as this would cause bare or thinly covered spots. Large ones should be turned from time to time. Those of very irregular form are best held in pans of specially adapted shape; sometimes it is well to have a metal coverplate which will lie on them and make better connection with the pole. The bottom of the bath gets gradually covered with sediment; and this should be removed from one to three times a week, in the morning, when the bath is cold. The clear bath liquid can be siphoned off by a clean rubber hose into a clean wooden tank, without disturbing the sediment; the bath tank is then to be scrubbed and rinsed with pure water.—*Abstracted from The Electrical Magazine (London), June 15.*

AN ENERGY DIRECTION INDICATOR.

The uncertainty of the working of reverse current relays on alternating-current circuits has been the subject of much recent discussion. In some cases, perhaps, failure in working is due to want of adjustment of the apparatus to meet the conditions, since most modern instruments provide for adjustment for phase displacement, surging, drop of pressure, etc. Although the conditions may not always admit of the use of relays, yet to couple generators direct to the busbars must be regarded as a practice involving a serious risk—a vital part of a system, which otherwise is protected throughout, being left without any protection of any kind. Even if the inductance of the machine prevents a disastrous rise of current, this partial protection does not apply to the cables between the machine and the busbars. Though a prompt indication at the beginning of the trouble is not so effective as automatic action, it is clearly better than nothing, and an instrument for indicating when an alternator is supplying energy to, or receiving energy from, the busbars has been in use for some time in America. It depends for its operation on a relay, which closes a switch and thereby causes a red lamp to



AN ENERGY-DIRECTION INDICATOR.

light up when the generator is receiving motoring current. This apparatus, however, has the disadvantage of depending upon a switch. An improved energy indicator (Andrews' patent), the action of which is purely inductive, as will be seen from the accompanying diagram, has recently been placed on the market by the firm of Cowans, Limited, of Salford, Manchester, Eng., and will doubtless be welcomed by many engineers. It is arranged to indicate by means of a green lamp when a generator is generating and by means of a red lamp when a generator is motoring. In the illustration, *A* and *B*, respectively, are red and green lamps connected across independent secondary windings. The combined effect of the series and shunt windings is to light the green lamp *B* when the series is in phase with the shunt—*i. e.*, when the generator is feeding energy into the busbars—and to extinguish the green lamp and light

the red lamp on a reversal of the series current relatively to the electromotive-force. Among the uses of this energy direction indicator may be mentioned: (1) To indicate a faulty generator when several machines are connected in parallel; (2) to indicate when the load on a machine has fallen to zero in switching out a machine; (3) to indicate the direction of energy in a distributing network, an ammeter merely giving the amount. These indicators are designed for use on circuits up to 10,000 volts, and made for either high-tension or low-tension current. The high-tension apparatus is designed for connecting directly in series with the high-tension circuit, while the low-tension apparatus is arranged for connecting in series with the secondary circuit of current transformers. In either case the potential windings must be supplied with low-pressure current, and not directly from the high-tension busbars, as shown in the illustration, in order to simplify the connections.—*Abstracted from The Electrician (London), June 25.*

ELECTRIC STORAGE-BATTERY OMNIBUSES.

The city of Brighton, in England, has recently installed a unique omnibus service employing storage batteries for the propulsion of the vehicles, and remarkable for the methods used in the charging of the batteries. The electric omnibus has many obvious advantages for public-service work, if the cost of battery charging and maintenance can be brought to a reasonable figure, and the advances made in this direction of late appear to open up a considerable field of usefulness for them where gradients are not excessive and a sufficient number of vehicles can be employed to secure economical methods of working. For municipalities with their own electric supply, the electric omnibus offers several attractions. The whole problem of the financial success of the electric omnibus hinges on battery first cost and maintenance, and the cost of the electrical energy required for charging the batteries. The upkeep of an electric chassis is very small as compared with that of a gear-driven gasoline omnibus. Within the last two years the first cost and maintenance of traction batteries has been greatly reduced, and manufacturers are attacking the weight question with gratifying results. In appearance the new storage-battery omnibus is not unlike the Hallford gasoline-electric vehicle, which has now run 50,000 miles in the service of Thomas Tilling, Ltd., the well-known 'bus and cab proprietors of London. The new omnibuses are of the Hallford-Stevens pattern, manufactured jointly by J. and E. Hall, Ltd., of Dartford, and W. A. Stevens, Ltd., of Maidstone. In this purely electric omnibus, a storage battery takes the place of the engine and dynamo in supplying the current to the electric motors, which are accessibly mounted on the side frames, and drive by means of cardan shafts (enclosed in steel tubes, which also form torque rods), the worm gears in the axle. The bonnet is retained, and the radiator is replaced by a light aluminium frame which carries the starting resistance. The space under the bonnet is occupied by the Hallford-Stevens patent interlocking controller. In this position it is very accessible, and the increased smoothness of running obtained by the longer wheel base well justifies this arrangement. The battery used on these electric omnibuses has forty-seven cells of a capacity of 500 ampere-hours at the five-hour rate. The cells are arranged in the main battery box, in five lines of eight, and one line of seven cells, a vacant space being left at the end of the last row, for convenience of removing the cells from the box. The charging voltage of the batteries varies from 100 at the beginning of the charge to 130 when fully charged. A very economical method of dealing with this variation of voltage is employed, which entirely avoids the usual heavy waste in series resistances on each battery circuit, a loss in some cases amounting to as much as twelve per cent of the total. Speaking generally, the system is to take the supply at constant voltage, and to insert in circuit with each battery the armature of a motor-driven booster of the interpolar regenerative type. By means of a potentiometer rheostat in the booster fields, the booster can be made to absorb electrical energy in the earlier stages of the charge, running as a motor and causing the erstwhile motor to which it is direct-coupled to act as a generator, returning current to the line. As the voltage required by the battery rises, the resistance of the booster fields is progressively short-circuited by means of the potentiometer rheostat, until the average voltage is reached. At this point the shunt field windings of the booster are short-circuited, and the armature of the booster is inert, only serving as a conductor in series with the battery. By a further movement of the potentiometer resistance switch, the current in the shunt fields of the booster is reversed, and the voltage is gradually raised until the maximum value is reached, when the battery is fully charged; during the latter stage the booster armature is generating electrical energy and is driven by the machine to which it is direct-coupled. At Brighton, the supply is from the public mains, and the voltage is from 220 or 230 volts on either side of the middle wire. Until quite lately the batteries were charged in series with a motor-driven booster in series with each pair of batteries. With an increase in the number of electric vehicles, however, it became necessary to build new premises for their exclusive accommodation, and the directors of the omnibus company decided to adopt the Stevens regenerative battery-charging system for the new garage, the electrical energy being supplied from the Brighton Corporation mains. Already about 7,000 to 10,000 units are being taken weekly. As a middle wire of sufficient capacity was not available in the neighborhood, the outers only at a pressure of 460 volts were brought to the building, and a balancer was installed to create the middle point. The main supply is connected across the outer terminals of the balancers, which are direct-coupled by means of flexible couplings to a line of reversible booster armatures, four on each side, so that the system when complete will consist of ten machines running on the same axis. At the present time only two boosters are connected on each side of the balancers, but provision in the foundations is made to add additional boosters as required. The circuit from each booster is through a fuse, reverse-current circuit-breaker and ammeter to the terminals of a battery, the circuit being completed through the middle wire. A four-way double-pole voltmeter switch is provided on each panel, so that the voltmeter can read line volts, battery volts, or booster volts or can be connected across the circuit-breaker so that the circuit can be closed when the potential difference as shown on the voltmeter (which is graduated forty volts on one side of zero and 300 on the other) is nil. In the earlier conditions the boosters are running as motors, but when the charging of the batteries is more fully advanced they run as dynamos, and the energy required is small. The plant when completed will have a charging capacity of sixteen batteries at one time, and the total losses in conversion from 460 volts to the voltage required for individual batteries will not exceed five per cent.—*Abstracted from Electrical Engineering (London), June 24.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Continued Improvement of Westinghouse Business.

The condition of improvement which the Westinghouse companies find their business has undergone during the past month maintains the same steady rate of advance already noted during the previous months of the present year, assuring before the close of 1909 a repetition of the busy times of 1907. The Westinghouse Air Brake Company, Wilmerding, Pa., has received a large number of orders for brake apparatus and friction draft gear. As an index of the improved conditions at the Union Switch and Signal Company, Swissvale, Pa., this plant is now employing about twice the number of men of a year ago. In June, the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa., enjoyed an improvement of twenty-five per cent over its business of May. A large order for railway motors secured from the New York Elevated Railroad Company is noteworthy. Switchboards and supplies, amounting approximately to $500,000, have also been ordered by the Pennsylvania Tunnel Terminal Company for the New York terminals and tunnels of the Pennsylvania Railroad. In line with the encouraging improvement noted by the Westinghouse Machine Company, the Philadelphia Rapid Transit Company has recently placed orders for two steam-turbine equipments, of 6,000 and 12,000 kilowatts capacity, respectively.

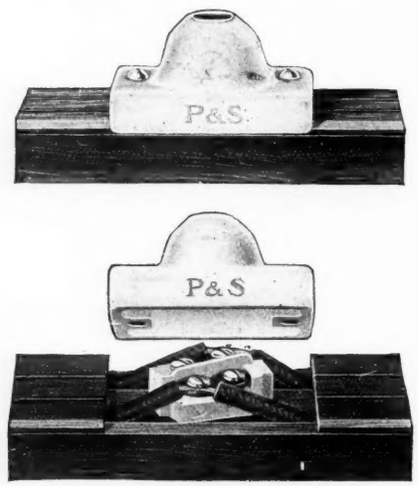
Popularizing the Electric Oven.

It is reported from Blackpool, Eng., that Charles Furness, the borough electrical and tramways engineer of that city, has formulated a scheme whereby electric ovens will be hired out at a rental of $0.75 to $1 a quarter. Experiments have shown that electricity at two cents a unit can compare with gas at sixty cents a thousand, for cooking purposes. If the proposed rental proves insufficient to cover interest and maintenance charges, Mr. Furness does not propose to raise the price, but to make up the difference from the charge for current. He figures on making no profit at all for eighteen months, as he considers it necessary to offer every inducement to give electric cooking a fair start.

Two-Piece Molding Rosettes.

In the two accompanying illustrations are shown a new two-piece fuseless molding rosette made by Pass & Seymour, Inc., of Solvay, N. Y. The upper view shows the device mounted with its cap in position. The lower view shows it with its cap slightly raised to show its interior construction.

It is to be noted that the small inside piece with the metal parts is mounted directly on top of the molding, which does not have to be cut to receive it. Nor is it necessary to cut the wire, since



TWO-PIECE MOLDING ROSETTES.

the latter simply loops up over the terminal plate at the extreme point and goes under the head of the upper contact screw.

Within the cap there is ample room for the knot of the lamp cord, which is fastened under the two inside screws on the terminal plates. The entire rosette is secured to the molding by means of two screws passing through the holes in the cap. This makes a neat and finished job, which can be completed in a very short time. The new rosette has been tested and approved at the Underwriters' Laboratories.

Orders for Allis-Chalmers Steam Turbines.

Allis-Chalmers Company has, of late, been shipping out a large number of steam turbines to fill recent contracts, among the number being machines of 500 to 3,500 kilowatts capacity for the Brush Electric Light and Power Company, Galveston, Texas; Oak Park Power Company, Flint, Mich.; Savannah Electric Company, Savannah, Ga.; Florida Mining Company, Mulberry, Fla.; Glenlyon Dye Works, Phillipsdale, R. I.; Willamette Valley Company, Springfield, Ore.; Pacific Mills, Lawrence, Mass.; Cia Electrica y de Ferrocarriles de Chihuahua, Mex., and Oshkosh Gas Light Company, Oshkosh, Wis.

Orders now in drafting room or shop comprise units as follows: Western United Gas and Electric Company, Aurora, Ill., 1,000 kilowatts; Neenah Paper Company, Neenah, Wis., 1,000 kilowatts; Cleveland Cliffs Iron Mining Company, Ishpeming, Mich., 2,000 kilowatts; Royal Weaving Company, Pawtucket, R. I., 1,500 kilowatts; North Adams Gas Light Company, North Adams, Mass., 1,000 kilowatts; Merchants' Heat and Light Company, Indianapolis, Ind., 2,000 kilowatts; Municipal light plant, Anderson, Ind., 500 kilowatts; Clinton Sugar Refining Company, Clinton, Iowa, 750 kilowatts; Anderson & Middleton Lbr. Company, Aberdeen, Wash., 300 kilowatts; Kenosha Electric Railway Company, Kenosha, Wis., 300 kilowatts; Fraser River Lbr. Company, Fraser Mills, B. C., 750 kilowatts; Northwestern Gas and Electric Company, Walla Walla, Wash., 1,000 kilowatts; Wilkesbarre Gas and Electric Company, Wilkesbarre, Pa., 1,500 kilowatts; Eastern Pennsylvania Railways Company, Pottsville, Pa., 1,000 kilowatts; Delaware, Lackawanna & Western Railroad Company, Scranton, Pa., 2,000 kilowatts; Colorado Springs Electric Company, Colorado Springs, Colo., 1,500 kilowatts; Aldrich Manufacturing Company, Moosup, Conn., 300 kilowatts, and Great Southern Lbr. Company, Bogalusa, La., 1,000 kilowatts.

Water Softening by Electricity.

A new water-softening process was described by J. L. Campbell in a recent paper before the American Railway Engineering and Maintenance of Way Association. Aluminum or iron plates were suspended in the water and an electric current passed through. The experiments proved highly successful.

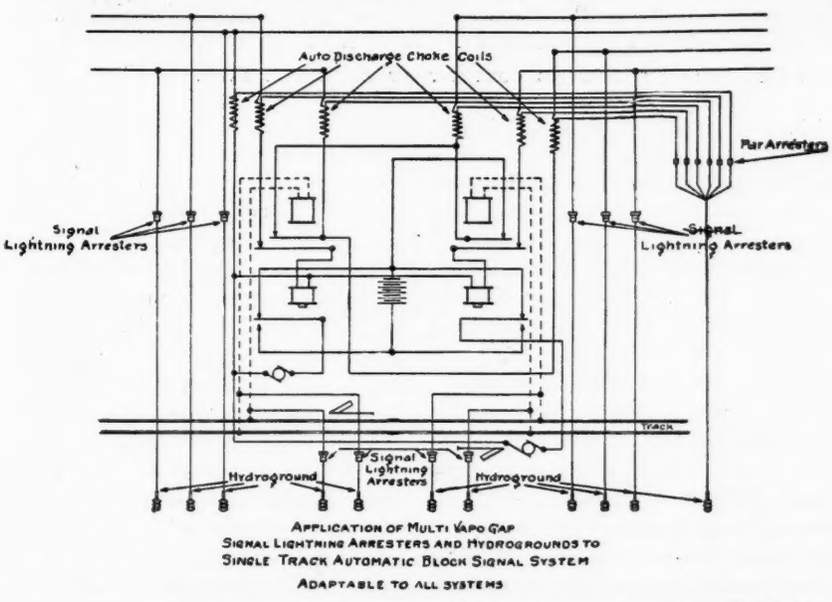
Lord Lightning Arresters and Grounding Devices.

The Lord Electric Company, of New York, has developed a new form of lightning arrester, making use of a discharge path akin to that found in nature. This device is designated as the "Multi-Vapo-Gap" lightning arrester. As its name implies, the arrester contains a hygroscopic medium forming a vapor cloud, through the numerous globules of which the lightning discharge finds multiple paths to ground. This cloud, however, is practically a non-conductor for the normal line current and forms an effective barrier to its leakage to ground. Therefore, no air gap is necessary. On tests this arrester has been shown to have a negligible equivalent spark gap, which is due to its insignificant impedance, since the multitude of moisture globules are very close together, though mechanically separated from each other. These features make the building up of static charges on the line impossible.

MULTI-VAPO-GAP LIGHTNING ARRESTER FOR SIGNAL CIRCUITS.

LORD ELECTRIC COMPANY'S HYDRO-GROUND.

In construction, the Multi-Vapo-Gap arrester is a very simple and compact device. The body of the arrester is a highly hygroscopic mass which maintains mechanically and chemically a fixed and definite volume of moisture in suspension. Being hermetically sealed in a white or chocolate glazed porcelain housing, this moisture is maintained indefinitely. It contains no metal except the terminals, nor carborundum, graphite or any other form of carbon. There are no moving parts. There is provided a telltale, which indicates and records any discharge; this can also be used to open the circuit when testing. The arrester is built in three forms, suitable for high-tension circuits, circuits under 1,000 volts, and signal circuits of all kinds. In the accompanying illustration is shown the form of the arrester adapted to the latter service. It gives an excellent idea of its compactness as well as the clear designation of its terminals.


Auto Discharge Choke Coils
Par Arresters
Signal Lightning Arresters
Signal Lightning Arresters
Track
Hydroground
Signal Lightning Arresters
Hydroground
APPLICATION OF MULTI VAPO GAP SIGNAL LIGHTNING ARRESTERS AND HYDROGROUNDS TO SINGLE TRACK AUTOMATIC BLOCK SIGNAL SYSTEM
ADAPTABLE TO ALL SYSTEMS
ARRESTERS MAY BE CONNECTED TO ONE COMMON GROUND, BUT INDIVIDUAL GROUNDS ARE PREFERABLE

APPLICATION OF LIGHTNING ARRESTER AND GROUNDING DEVICE.

The subject of effective grounding has interested electrical men for some years since it was found that the means formerly in vogue were very commonly unreliable. The Lord Electric Company, as the result of considerable experimenting in this line, has perfected a device termed by it the "Hydro-Ground," which is giving very satisfactory results. It consists, as shown in an accompanying view, of a number of ovoid disks mounted on a central metallic supporting rod. These units are of a substance which is highly hygroscopic and which retains indefinitely the moisture that it draws to it. This material is non-metallic, unaffected by acids or alkalies, and is not liable to electrolytic action. The installation of a Hydro-Ground is a simple matter, as it is necessary merely to dig a deep hole with a post-hole auger to bring it into the layer of damp earth. Ground wires are easily attached to its stem. After setting it on the ground strong brine is poured over the disks and salt is mixed with the earth used to fill in. This insures good earth contact, but does not corrode the Hydro-Ground as it would an iron pipe.

In the diagram herewith is shown the application of the Multi-Vapo-Gap lightning arresters and Hydro-Grounds to a single-track automatic block-signal system. It also shows a series of auto-discharge choke coils that have been devised by the company as an additional means to insure immunity from static disturbances. These devices have been proven to be adaptable to all systems and have been found to give excellent service.

Magnetos and the Automobile.

According to J. S. Bretz, president of the J. S. Bretz Manufacturing Company, New York, N. Y., importers of the Unterberg and Hehmle high-tension magnetos, the year 1910 will see the magneto in undisputed possession of the ignition field. Mr. Bretz avers that next year the magneto will be furnished as an integral part of the gasoline automobile and not offered as an extra or an option at an additional price.

Western Electric's Half-Year.

While the first half of the fiscal year of the Western Electric Company, ended with May, shows an improvement in business and an increase in sales volume far ahead of expectations six months ago, the most satisfactory element of the situation and the one upon which the officers are felicitating themselves most, is the fact that the company is making money under present market conditions. An officer says:

"May 31 ended the first half of our fiscal year. Our business is running at the rate of approximately $46,000,000. This would compare with $33,000,000 for the fiscal year of 1908 and $53,000,000 for the fiscal year 1907, and the percentage relation is an improvement of forty per cent in the first case, and at the rate of eighty-seven per cent of the 1907 record. The present business outlook seems to us good but without anything to lead us to expect an unusual growth in our business. A sure and steady increase, however, may be confidently looked forward to if business conditions continue along the lines they are doing at present."

The increase in the machinery sales for the half-year was forty per cent over the same period a year ago and closely reflects the improvement in industrial conditions since a large part of the machinery orders were for additions and improvements.

Gross business for the first quarter of the fiscal year ran at the rate of $42,000,000 per annum, and for the last quarter at the rate of nearly $50,000,000 for the year, an increase of about nineteen per cent. While the business for May is usually ahead of the business of the preceding month, the increase of May, 1909, over May, 1908, showed approximately sixty per cent. The month of April, 1909, showed an improvement equivalent to fifty per cent over that of April, 1908, and if the ratio of improvement of the last two months continues the company will easily attain a $50,000,000 year.

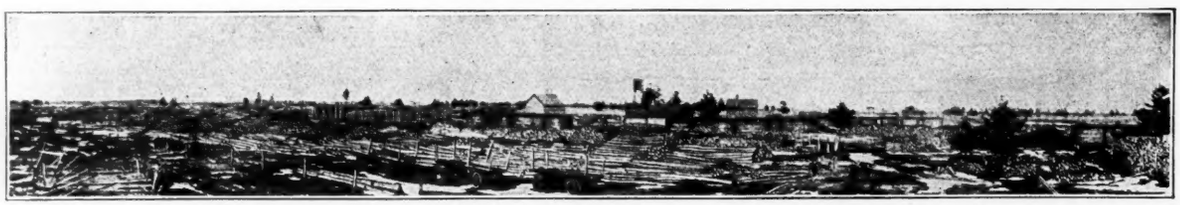
The business with the farmers in the agricultural states has been satisfactory and with the good crop prospects that exist at present there is every prospect that this development will continue.

The volume of the company's orders for the six months increased about thirty per cent over the same period in 1908 and the average value per order increased approximately ten per cent. In certain lines the volume of orders increased more than fifty per cent.

The export business for the most part has not felt the impetus of the improvement in this country, running only slightly ahead of last year. The European business from the company's foreign plants, however, gained thirty per cent over a year ago and was twelve per cent greater than 1907, which previously held the high record. This remarkable gain is due to the fact that the company's trade with foreign countries is not so much dependent upon industrial conditions as the condition of the foreign governments' exchequers.

An Interesting Pole Yard View.

A panoramic view of the immense cedar pole stock of the Kellogg Switchboard and Supply Company, at Escanaba, Mich., was recently obtained and is produced herewith, which is interesting because of the difficulty in obtaining satisfactory views of this kind of a subject where a wide area must be covered, and yet bringing out clearly the important details. It shows quality stock, manner of piling, handling, wagon and train loading. This pole yard is economically laid out for quick shipments and low prices.



THE POLE YARD OF THE KELLOGG SWITCHBOARD COMPANY AT ESCANABA, MICH.

Induction Furnace for Brass Smelting.

An electric induction furnace has been suggested for brass smelting which possesses several good points. By covering in the furnace before the melting temperature is reached the oxidation of the zinc should be materially reduced. Brass and similar alloys at present are usually melted in crucibles in coke furnaces, a method which is wasteful with fuel and difficult to regulate, besides incurring a loss of zinc through oxidation. It is expected that the new process will meet with considerable success.

Western Electric Exhibit at Detroit.

An interesting feature of the convention of the Superintendents of Telegraph, held in Detroit, Mich., from June 22 to 25, was the Western Electric Company's exhibit of train-dispatching telephones. These attracted much attention and won favorable comment, as the systems were in actual operation and represented the latest development in telephone train-dispatching equipment.

Two types of selector equipment were shown: The Cummings-Wray standard, with a sender and four stations, and the Gill in two types, namely, the individual-call and the high-speed multiple-call, one sender and four stations of each.

The attention of visitors at the exhibit was directed to the many styles of apparatus developed especially for railway use. This included transmitters, receivers, desk stands, transmitter arms, head telephones, keys, loud-speaking receivers, portable sets, line poles, hand sets, foot switches, test panels, protectors, dry batteries, siding telephones, extension bells, and hand generators. Any of this equipment shown could be used with either the Gill or Cummings-Wray dispatching systems. Other pieces of equipment that were thought to be of general interest to railroad men, such as telegraph relays, emergency cable, cords, composite sets and howlers, were also shown.

The exhibit of transmitter arms was of special interest, including several distinct types, each having special features. Those shown were the Van Akin, the W. E. Special, the Flexiphone, the No. 1020 and the No. 20 desk stand.

The convention days fell in the midst of the late June hot wave. Western Electric fans were placed in the company's booth, and these rooms soon became popular. Similar fans were placed in the convention room and were much appreciated. The company also distributed trademark paperweights of unique design.

Representing the company at the convention were W. E. Harkness, R. F. Spamer and H. L. Burns, of New York, and C. L. Howk and J. H. Finley, of Chicago.

A Supplementary Storage Battery for 24-Hour Service.

The generating equipment of the town lighting plant at Eddyville, Iowa, consists of a fifty-five-kilowatt, 220-volt, direct-current generator belted to a Corliss engine. During the year 1908, the load during peak hours reached, and, in fact, exceeded, the rated equipment of this set, thus necessitating increased capacity. It was felt that if a twenty-four-hour service could be maintained, the number of customers could be materially increased, the twenty-four-hour service being an additional inducement to use electric light and power. An attempt had been made to run a day circuit by operating the generating unit, but the expense of this method proved prohibitive.

A battery installation was therefore considered, and was placed in service in January, 1909, for the purpose of providing twenty-four-hour service, and supplying the excess peak load. This battery consisted of 130 cells of "Chloride Accumulator," manufactured by the Electric Storage Battery Company, of Philadelphia, with a capacity of twenty-five amperes for eight hours. It was found that the battery could be charged during the normal run of the steam generating plant, and would then have sufficient capacity to supply the demands for service after 11 p. m., when the plant was shut down. On occasions when the load during the peak is in excess of the generator capacity, the battery is also used to assist the generator. At infrequent intervals, a comparatively heavy demand is made on the plant by the Opera House, lodge halls and churches, and on such occasions the battery is available for supplying the excess demand.

Since the installation of this equipment a material increase has been noted in the number of customers, and since this is a municipal plant it is felt that the battery has been of manifold advantage, as it has not only increased the receipts, but has greatly improved the service.

Pure Wax Sheets for Condenser Dielectrics.

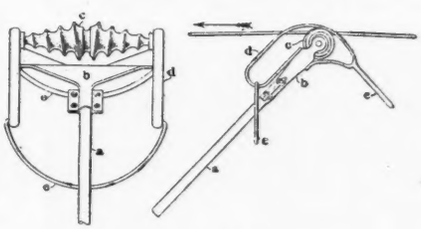
An interesting paper forming Memoir No. 18 of Vol. XLIV of the proceedings of the American Academy of Arts and Sciences, tells of the researches of C. L. B. Shuddemagen, of the Jefferson Physical Laboratory of Harvard University, on the residual charges of condensers with dielectrics of various materials.

Mr. Shuddemagen, in this paper, describes a new method of making condensers with pure paraffin wax. In preparing the thin wax sheets, he dips a thin, smooth board which has been soaked for a few days in water, and rinsed with water before use, into a bath of liquid paraffin wax. The sheet of wax on each side of the board is readily detached when the board is withdrawn from the bath. The thickness of the sheet is determined by the temperatures of the bath and the board, and also, of course, the time of immersion. Half a millimetre has been found a suitable thickness. Irregularities in the surface of the sheets are smoothed with the blade of a safety razor before the tin foil is placed on the sheets.

The condensers made in this way show no residual charge, and are thus likely to prove of great value in future electrical work.

A New Trolley Wheel.

A unique form of trolley wheel is described in a recent British patent granted to F. Kompe, of Berlin, and has already been tried out on the trolley system in Cologne, Germany. The idea of the invention is to prevent the trolley wheel



A NEW TROLLEY WHEEL.

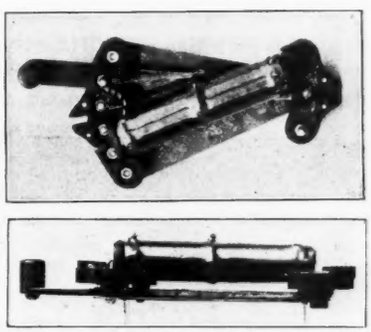
from leaving the wire, and, as will be seen from the accompanying illustrations, this is effected by means of a spiral device on each side of the trolley wheel proper, and integral with it, which tends to deflect the wire back into the central channel as the wheel is rotated by its running frictional contact with the wire.

In the illustration *c* is the double-conical spirally-grooved trolley wheel; *b* is a sheet-iron fork, provided with ball bearings, and fixed to the pole *a;* rigid side arms *d* connect with the fork, as shown. An extension is provided at each end to depress the roller if the wire leaves the central groove just before a span wire. The object of the arms is to prevent the wheel being thrown off the wire altogether, as when the wire is jerked out of its central position it strikes one of the two arms, and rebounds on to some portion of the spiral groove. In ordinary circumstances the arms do not come in contact with the span wires and other obstructions. When the car is running on a single-track section with the two trolley wires close together, the lower portions *e* prevent the second wire from being jerked under the arms *d*.

While the device is ingenious in design and construction it is doubtful whether in its present form it will supersede to any great extent the well-tried and efficient trolleys it is intended to replace.

Fan Controller.

The Ward Leonard Electric Company, Bronxville, N. Y., has placed on the market a complete three-speed and open step fan controller for desk fans, illustrations of which are shown herewith.



THREE-SPEED AND OPEN-STEP FAN CONTROLLER.

The resistance of these controllers consists of Ward Leonard enameled resistance units, the resistance wire being hermetically sealed from the disintegrating effects of the atmosphere. They are furnished complete ready for mounting in the base of eight-inch, twelve-inch and sixteen-inch desk fans.

Improvement in Nernst Lamps.

The instantaneous lighting Westinghouse Nernst lamps exhibited at the Atlantic City convention of the National Electric Light Association mark another important step in the development of the glower system.

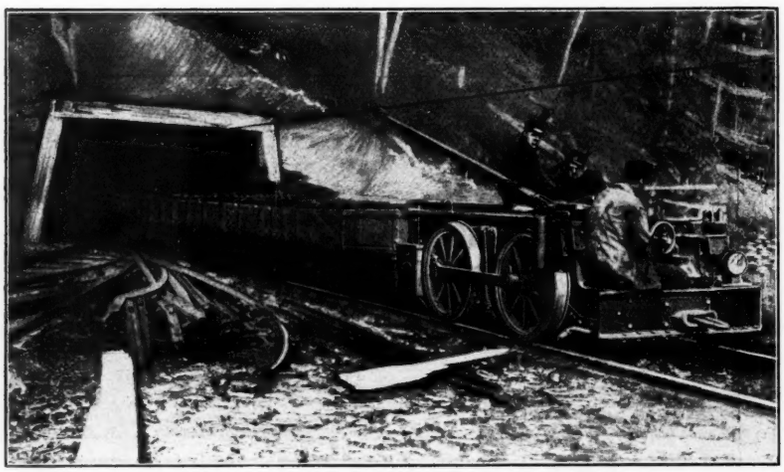
The desirable feature of instantaneous lighting is accomplished by the substitution of a new form of heater for the old platinum heater. This heater becomes luminous immediately upon the passing of the current, and in addition to producing light instantaneously is so constructed that it causes the glower itself to light in ten seconds.

The Nernst company announces that on and after July 1, it will be prepared to deliver 88, 110 and 132-watt, 220-volt type alternating-current and direct-current lamps equipped with the instantaneous-lighting burners.

The Roan Type Gathering Locomotive.

An improved electric mining locomotive of the "gathering" type, in which a single powerful motor performs the functions of both propulsion and operation of the gathering reel, has been brought out by the Westinghouse Electric and Manufacturing Company and the Baldwin Locomotive Works, under the patents of an invention of J. M. Roan. Mr. Roan, who is general manager of the Clinchfield Coal Corporation, is a practical mine operator, and on this account the gathering locomotive of his invention may be relied upon to meet exactly the requirements demanded by the practical mining man.

In the Roan gathering locomotive the single motor used to drive the wheels is arranged to be detached and connected to the wire-rope gathering reel. The wheels or the reel may thus be operated either independently or simultaneously, winding up the rope while the locomotive is moving.



ROAN TYPE GATHERING LOCOMOTIVE.

The arrangement described secures advantages of flexibility, compactness and reduced amount and cost of electrical apparatus, attained in no other type. The provision of one powerful motor to perform the duties of both gathering and driving motors cuts in half the motor and controller expense, at the same time making the total power of the traction motor available for the gathering reel.

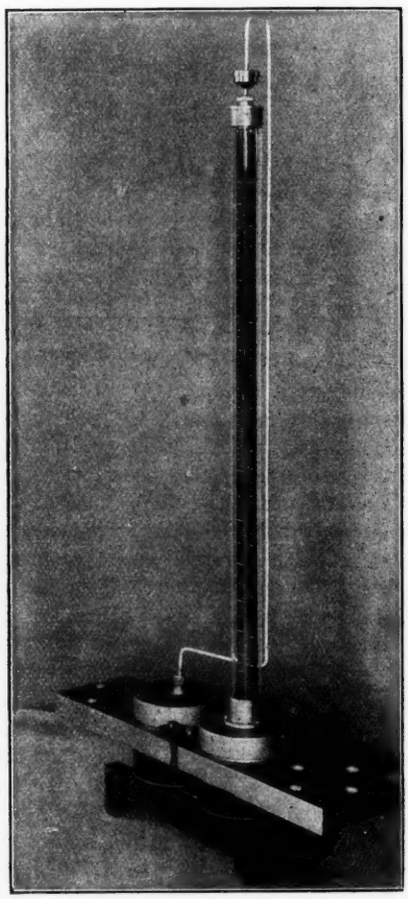
When loaded cars are to be hauled from the working face to the butt heading on which the locomotive stands, the rope is paid out and attached to the cars. The main driving motor is then unclutched from the axle and connected to the reel which winds up the rope, drawing the car toward the locomotive, which stands, with its brakes set, on the heading track. The provision for propelling the locomotive at the same time the reel is in operation enables the cars to be swung on to the heading without sawing the rope on the rib at the room neck. In service many applications have suggested themselves for the combined tractive and hauling-in actions secured from the motor. Derailed cars may be easily replaced on the track, timbers and rails recovered from under falls of rock, rails loaded on cars, and in fact the reel can be used for any kind of general hoisting work.

The motor transmits its power through a single spur gear directly to one axle. The two axles are connected together by side rods spaced ninety degrees apart, securing increased tractive effort beyond that of any single-motor or two-motor locomotive. As shown, the wheel base is extremely short, although the wheels are of full size, and the maximum amount of service is secured by the spring suspension of the frame and motor. The locomotive frame is made up of steel angles and plates, giving maximum strength for a given weight.

The Leeds & Northrup Mercury Ammeter.

The problem of measuring large alternating currents with any degree of precision with any of the various types of instruments which have been on the market, is, from a technical standpoint, a difficult one. All who have had any experience in this class of work agree that there is need for a standardization instrument, which can be inserted directly into an alternating-current circuit carrying 500 amperes and over which will measure this current to the same degree of precision that small currents may be measured.

As a suggestion toward an instrument which would meet these conditions, in 1907, in a paper entitled "Some Newly Observed Manifestations of Forces in the Interior of an Electric Conductor," published in the *Physical Review*, June, 1907, Dr. E. F. Northrup proposed an alternating-current ammeter based on the forces he described. At that time a crude instrument was shown. Since that time, the Leeds & Northrup Company, of Philadelphia, has steadily perfected this instrument until it has reached a point where, practically speaking, it believes the only limit to accuracy of the instrument is the accuracy to which the ultimate unit of current is known. A paper descriptive of the developed instrument, its theory and tests of accuracy, was read by Doctor Northrup at the meeting of the American Electrochemical Society at Niagara Falls, Canada, May 6-8, 1909.



THE LEEDS & NORTHRUP MERCURY AMMETER FOR MEASURING LARGE CURRENTS.

The Leeds & Northrup Company states that its new instrument, which is designated the "mercury ammeter," is intended for use as a primary standard instrument for large currents, either alternating or

direct. It is intended for the calibration of station instruments, and for use in the determination of series-transformer ratios.

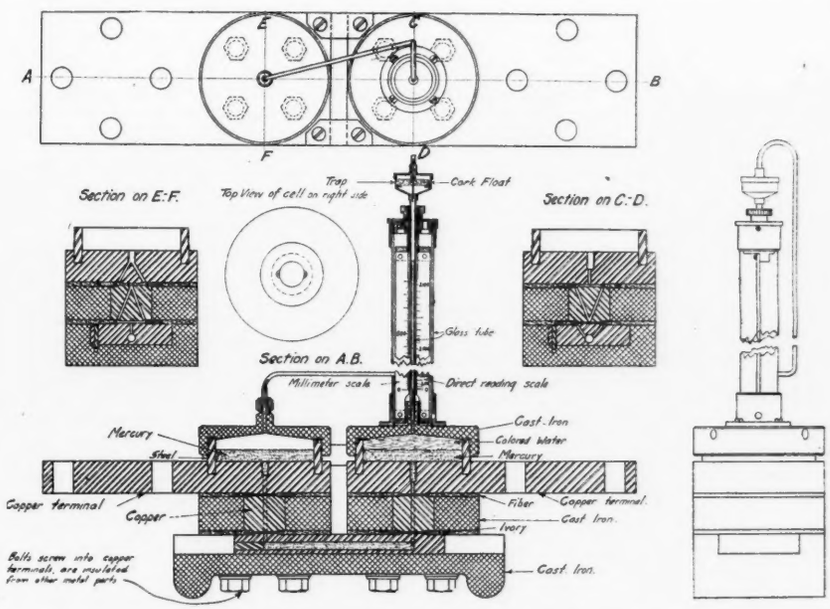
The mercury ammeter is intended for use in the measurement of currents of 200 amperes and over. The lowest practical range in the present type of instrument has a full scale corresponding to 500 amperes, and this instrument on 200 amperes may be read to one-fifth per cent accuracy. The standard length of the scale is about twenty-two inches.

Very exhaustive tests have been conducted on a number of these instruments using the potentiometer with direct current, and Kelvin balances with alternating current as calibrating instruments. In brief, it has been shown that this mercury ammeter may be read over three-quarters of the scale to an accuracy of 0.1 per cent, this accuracy being totally independent of the kind of current being measured; that is, the same instrument is equally accurate upon direct current and alternating currents of any wave form, and any frequency up to 133 cycles. The scale follows the square law, and the reading is in terms of the mean square value of the current. Also, the tests have shown that the temperature coefficient of the instrument is negligible when it is used as a standard.

A great deal of care was exercised in the determination of the effects of external currents upon the indications of the instrument. The results showed that appreciable errors resulted only when conductors, carrying heavy currents, were placed directly over or directly under the instrument in contact with the base. For instance, when a conductor carrying a current equal to the full scale reading of the meter (2,000 amperes) was placed over the base of the instrument parallel to its length, and in immediate contact with it, a 0.3 per cent error resulted. This was the maximum error observed, and when the distance between the conductor and the instrument was increased, the error rapidly diminished.

With regard to the constancy of the mercury ammeter, an instrument built in 1907, embodying all of the essentials of the present instrument, at the present date shows absolutely no perceptible change.

It has a period of about five seconds, that is, it will pass from zero to full-scale reading in five seconds. For facility of reading, the meter is built to be just short of "dead beat."



DETAILS OF MERCURY AMMETER FOR MEASURING LARGE CURRENTS.

The operation of the instrument is quite simple. The copper terminals of the instrument are bolted into the circuit without any regard for polarities. The zero of the instrument is roughly adjusted by leveling, and finally by turning the thumb nut at the top of the tube. The current is then thrown on, and the colored liquid will flow up to a point in the scale corresponding to the current flowing. The current is then read directly from the scale.

It is beyond the scope of the present article to go into the details of the theory of the mercury ammeter. However, a very simple analogy will serve to make clear the essential principle of the instrument. Wires, when carrying current, tend to attract each other so that were they fastened at the ends, they would swing together at their center. We can consider a liquid conductor as being made up of an infinite number of elemental conductors, parallel to the directions of flow of the current. With this in mind it is desirable to look at the cross-section views of the ammeter. The right-hand and left-hand sections will be seen to be very similar in construction, and to consist of copper plates alternating with insulating plates, having various holes drilled in each side, and closed reservoirs for mercury. Attention should be focused on the cross-sections on E F and C D.

The current, we will say, enters through the upper copper leaf. To get to the next copper leaf of the cell it must pass through the mercury-filled space within the ivory ring, shown dotted in the cut. In passing through the disk of mercury it causes the mercury to tend to flow away from the edges and bank up at the center. The force causing this action is exactly the same force that causes solid conductors, carrying current, to tend to attract each other. This attraction toward the center causes the mercury to flow through two diagonal tubes, which extend from the circumference of the disk of mercury to the center reservoir of mercury. Thus a force is set up which tends to make the mercury flow through the tubes and disks of sections C D and E F and through the connecting tube in the base of the instrument from C D to E F. It will be seen that in the meter in question there are four points at which the force is exerted, two being in section E F and two in C D. This force causes the mercury to flow until it is just balanced by the force due to the difference in hydrostatic head between the levels of the liquids in the two sides.

It is an interesting fact that the ammeter consumes about one watt per inch of scale reading, regardless of the amount of current to which one inch of scale corresponds.

The calibration of the instrument is dependent only upon the number and diameter of the disks or cells, the density of the liquid which serves as an indicator and the force of gravity. The liquid is not exposed to evaporation and, due to the fact that the instrument involves only hydrostatic heads, the effect of variations in the diameter of the index tube is eliminated, as is also the possibility of error due to drainage effects. Within wide limits the calibration is also independent of temperature changes.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, JULY 1.—The large network of power lines known as the South Electric, which extends over a large area in the Mediterranean region of France, is now being increased considerably, and the present project calls for a supply of 250 different communes in this region, representing a population of 600,000. A large turbine plant located on the Vis River is used to furnish a part of the current. At the locality of Sommieres is a substation which serves as a distributing center, and it receives the power line of twenty-seven miles length coming from the turbine plant, lowering the voltage from 50,000 to 13,000. About 5,000 kilowatts is utilized in this plant. Another source of supply is the Brillanne hydraulic plant, and a sixty-mile power line coming from it ends at St. Victor, near Arles, where there is a substation erected. The power line voltage of 50,000 is lowered to 13,500 volts at this point. It is intended to install a third substation in the Vaucluse department, which will receive current from the new turbine plant on the Ventavon River.

The trolley line which was erected along the Rue du 4 Septembre at Paris has finally been removed, to give place to the underground conduit system. The trolley system was only intended to be a temporary one and was installed during the subway work for the Metropolitan, when the conduit could not be put in place. However, it was allowed to remain for several years and was a subject of much discussion. Its removal adds much to the attractiveness of this quarter.

An international congress of radiology is to be held at Brussels in 1910. Information can be obtained from the secretary, at No. 1 Rue de la Prevoté.

The French Thomson-Houston firm has lately installed a tramway line which runs from Tunic to Carthage and the neighboring region.

At St. Leonhard, in the region of Salzburg, Austria, there has been installed a section of standard gauge electric railroad, which makes connection with the locality of Hallein. A. DE C.

GREAT BRITAIN.

(Special Correspondence.)

LONDON, JULY 3.—The municipalities are taking up a somewhat anomalous position with regard to the much-debated "wiring" clause in the Electric Lighting Acts (Amendment) Bill, which is now before Parliament. This gives the municipalities authority to undertake the wiring of consumers' premises for electric lighting and also the hiring out of fittings, motors, etc. The House of Lords has amended the clause so that this class of work may be carried out by municipalities, but only through contractors. To this there is considerable opposition on the part of municipal electrical engineers, many of whom, however, state that although they do not believe in a municipality running a wiring department they do not wish to be tied down in this manner. This is a perfectly frank position to take up, but the somewhat curious wording of a resolution dealing with the matter passed at the recent annual convention of the Municipal Electrical Association rather prejudices the position of the municipalities when the Select Committee of Parliament comes to consider the point. The resolution in question was to the effect that if they cannot have the clause amended they will try and get it removed, but if this second alternative is unattainable then they will take the clause with the obnoxious restriction in it. This attitude will undoubtedly weaken the position of the municipalities and it would have been better to have taken a firm attitude either for or against the clause.

A good deal of discussion has been taking place of late on the question of how to deal with large consumers of electricity for power purposes. The real point under discussion is the method of charging such consumers; whether they shall bear a full share of the total capital charges upon the station in addition to the working costs or whether their share of the capital charges shall be confined to the newer plant from which they are supplied. The large majority of municipal stations, at any rate, were started many years ago as purely lighting undertakings and the capital expenditure upon the plant was naturally very high. Most of the recent extensions of plant have been for power supply and it is argued by many that the power supply should be treated as a separate business starting with the new plant. This is one aspect of the matter. Another point which is troubling many station engineers and managers is the question of discounts according to the time the supply is demanded. In some quarters there is an idea that the peaks can be leveled by giving sufficient encouragement to power users to make their demand at other times than the peak, and discounts of 80 per cent in regard to working costs are mentioned. Everyone seems to be working upon different bases, but the older stations with much out-of-date plant find the problem the most difficult to deal with. And the problem is not made the easier by the very cheap price of gas in many of our manufacturing cities in the provinces.

The first station relying solely upon British-made Diesel oil engines for giving a public supply of electricity has been opened at Chichester, a historic town in the south of England. Two 150-horsepower generating sets have been installed and the engines contain a number of features which are not common to those of continental build. Apart from the Diesel engines and the circumstances under which they have been installed, there is little of note in the station, which is quite a small one.

Great progress is being made with the formation of the Institution of Mining Electrical Engineers. It was felt that none of the existing scientific societies covered this field and a central organization has been formed with branches in every mining district. So far the details of formation are not quite complete, but no doubt a working session will be commenced next autumn.

The action by the British Westinghouse Company against Mr. Braulik for infringement of the Bremer arc-lamp patents has been completed, but the judge has not yet given his decision. Braulik claims that Bremer was anticipated in no less than thirteen patents in various parts of the world. Disconformity is also alleged between the provisional and the complete specification of the Bremer patent. The main patents relied upon are two American ones granted in 1882 and 1896, respectively, to Graham and Crosby. Some importance attaches to the result of this case, as it is the intention of the Westinghouse Company, if successful, to enter similar actions against a number of other makers and importers of arc lamps.

The popular seaside resort of Brighton has, by reason of the refusal of the Council to sanction patrol omnibuses, the distinction of being the second town in the country to adopt electrically-driven omnibuses, the local bus company having just put a number into service. These vehicles differ in their construction from those running in London, as the motors are accessibly mounted on the side frames and drive onto the rear wheels by means of cardan shafts. The batteries consist of forty-seven cells, and a special substation has been erected for charging the batteries off the mains of the Brighton Corporation.

G.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, JULY 10.—The Montreal and Toronto stock exchanges, as well as many other Canadian financial concerns, have memorialized the Dominion government, praying for the disallowance of the act passed at the last session of the Ontario Legislature to validate certain contracts entered into by the Hydro-Electric Power Commission and the municipalities of the province.

A continuance has been granted of the injunction to restrain the city of Hamilton, Ont., from making application for power from the Hydro-Electric Commission until the trial of an action which has been instituted to quash the by-law that was recently adopted by the City Council, favoring an agreement with the commission.

The Porto Rico Railway Company has just decided to issue $500,000 preferred stock, and the shareholders are asked to meet, on July 28, in Montreal, to sanction the proposition. The money will be expended in extending the power lines to the eastern portion of the island. It is understood that a syndicate has agreed to take all the new stock, at par, not subscribed for by the stockholders.

The Erindale Power Company, which recently acquired from the liquidators of the Southern Light and Power Company the power station on Credit River, Ont., and land holdings at Port Credit harbor, is now arranging to proceed with the construction of the dam and the erection of buildings for the housing of machinery at the station with a view to delivering 1,000 horsepower to the distributors, the Stark Telephone, Light and Power Company, in Toronto, within six months. English capitalists are behind the power scheme. The capacity will be increased as the demand warrants.

The street railway company, Kingston, Ont., has notified the City Council that if no readjustment of the present condition of affairs can be made shortly, the company will discontinue its

service to the city. The company declares that it will not take any bonus to run the line, neither will it accept power at less than cost of producing. The company says that if matters, even the purchase of the line, cannot be arranged, then the inevitable closing must follow and the stockholders take their loss to date. R. V. W.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, JULY 10.—At a meeting of the shareholders of the Alameda Rural Telephone Company, held at Alameda, Sask., it was decided to immediately proceed with the construction of a rural telephone company.

The British Columbia Electric Railway Company has made a proposition to the City Council of Victoria, B. C., to construct a power plant in the vicinity of that city at a cost of $2,000,000 to supply both the company and the city with electric current.

The Riverside Telephone Company has been incorporated, with head office at Bouleau, Sask., and the Wall Lake Telephone Company, with headquarters at Dundurn, Sask. Both companies have been formed to build rural systems.

The city of Fernie, B. C., has purchased a site on which to erect a new municipal light and power plant. Address Mayor Tuttle.

At Michel, B. C., the Michel Water, Light and Power Company has been incorporated to supply that town with the commodities named. R.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

MEXICAN IRRIGATION PROJECT—The Chapala Power and Irrigation Company, which has just been organized with a capital stock of $8,000,000 Mexican money, will construct a $2,000,000 hydroelectric plant for the purpose of providing water for irrigation. It is probable that two of these power plants will be built—one to be located on the Santiago River near Guadalajara and the other on a stream that empties into Lake Chapala. Transmission lines will be built to operate the pumps which will be located upon the shore of Lake Chapala, the water of which will be used to reclaim 75,000 acres of land. The government loan of $3,000,000, and an additional loan of $2,000,000 from the Loan Bank of Mexico City will be used to build about 110 miles of main irrigating canals and to establish three pumping stations. The plans, when completely rounded out, will involve the irrigation of more than 500,000 acres. The Pimintel interests of the city of Mexico, which own the street railway, light and power systems of Guadalajara, are associated with Manuel Cuesta in the enterprise.

ROYAL GORGE POWER COMPANY, COLORADO—George A. Taff, of Colorado Springs, Colo., formerly president of the Empire Water and Power Company, who has just incorporated the Royal Gorge Power Company, with a capitalization of $2,000,000, intends to build two enormous electric power stations at the mouth of the gorge, to be operated by the waters of the Arkansas River and Grape Creek, with a combined capacity of 40,000 horsepower, to reclaim hundreds of thousands of acres of arid land in eastern El Paso and Pueblo counties. Transmission lines will be extended as far north as Colorado Springs, with laterals running eastward fifty miles whenever necessary. The project is expected to be a boon to agriculturists in the enormous dry farming region to be made irrigable. Farmers in the Grand valley are pumping water at a cost of $5 per acre on surfaces from 40 to 100 feet above the Grand River, thus showing the feasibility of Taff's plan. Mr. Taff says arrangements have been made for the underwriting of the bonds to finance the proposition and that about $2,000,000 will be invested.

LIGHTING AND POWER.

(Special Correspondence.)

STORY CITY, IA.—The city is to put in a $9,000 electric-light plant.

MINNEOTA, MINN.—An electric-light plant is being considered by this city.

ELDORADO SPRINGS, MO.—B. F. Proctor will establish an electric-light plant here.

RYAN, TEX.—This city has voted $6,000 in bonds to establish an electric-light plant.

SAYRE, OKLA.—This city has voted bonds to the amount of $15,000 for an electric-light plant.

CORDELL, OKLA.—The city will vote on a $10,000 bond issue for establishment of electric lights.

TALALA, OKLA.—The Talala Telephone Company has been incorporated by A. W. Campbell and others.

HYDRO, OKLA.—A bond election will soon be held here to vote on a bond issue of $25,000 for waterworks and electric lights.

AMARILLO, TEX.—The Amarillo Water, Light and Power Company plans improvements to cost $100,000.

AINSWORTH, NEB.—The Electric Light and Power Company has been incorporated with a capital of $60,000.

MONETT, MO.—The citizens of this place have voted to issue $35,000 bonds to build a municipal lighting plant.

SINTON, TEX.—J. M. Greer and others are organizing a company to establish a $100,000 ice and electric-light plant.

MAYSVILLE, MO.—The De Kalb County Electric Light Company has been incorporated by E. A. Bunton and others.

TACOMA, WASH.—H. M. Byllesby & Company of Chicago, Ill., have acquired the Tacoma Gas Light property in this city.

CALLAWAY, NEB.—The Callaway Electric Light and Power Company has been incorporated with a capital stock of $15,000.

SAN MARCOS, TEX.—The San Marcos Electric Light Company has had an additional twenty-five-year franchise granted.

BARTLESVILLE, OKLA.—The Bartlesville Light and Power Company has been incorporated with a capital stock of $200,000.

SAN JUAN, CAL.—The Town Trustees have awarded an electric-lighting franchise in this place to the San Benito Light and Power Company.

McMINNVILLE, ORE.—This place has voted a bond issue of $30,000 for the completion of the new electric-lighting and power plant on Baker Creek.

BENSON, ARIZ.—Manager Frank Treat, of the Benson Water Company, says that the company proposes to install an electric-light plant in the near future.

CLOVIS, N. M.—The City Council has awarded a $55,000 contract for a municipal light and water plant to the Mathews Construction Company of this place.

ALBANY, N. Y.—The Oswego County Light and Power Company has certified to the Secretary of State that it has increased its capital stock from $100,000 to $1,000,000.

PIERZ, MINN.—A twenty-five-year contract has been made with the Little Falls Water Power Company, of Little Falls, Minn., for lighting the village by electricity. C.

WAYCROSS, GA.—Another election has been called to determine the question of issuing $35,000 municipal bonds for building a city lighting plant. The election will be held July 28. L.

ALBANY, N. Y.—The North Creek Electric Company, of Johnsburg, has been incorporated with a capital of $25,000. The incorporators are C. S. Wood, J. H. Wade and C. S. Wade, North Creek.

SEATTLE, WASH.—The municipality will appropriate $100,000 for the commencement of work on the extension to the power dam and on the extensions to the distributing system in this city.

SEATTLE, WASH.—Leslie H. Adams and William Mullholland have applied for an electric-lighting and power franchise in certain sections of this county. The matter will be acted on on July 29.

BELLINGHAM, WASH.—The Whatcom County Railway and Light Company will expend approximately $100,000 this summer in laying heavier steel on the local system and making street improvements.

SAN FRANCISCO, CAL.—The Pacific States Electric Company has been incorporated here, with a capital stock of $500,000, by W. L. Goodwin, F. Fowden, J. C. Gibson, H. V. Carter and J. S. Eells.

TOLEDO, OHIO—The citizens of Fayette, Ohio, have voted in favor of a bond issue to raise funds with which to install an electric-lighting plant. The proposition carried by a vote of nearly six to one. H.

ELLENBURG, WASH.—The City Council has adopted plans whereby the municipal lighting plant is to be doubled in capacity. Bids are to be received for a 250-horsepower engine and a 500-kilowatt generator.

COEUR D'ALENE, IDAHO—The Coeur d'Alene Current Motor Company has been incorporated here, with a capital stock of $250,000, by G. E. Nevers, J. R. Nevers, C. M. Butfhor, F. E. Wonnacott and Guy Searles.

HAWKINSVILLE, GA.—The city will soon install an electric-lighting plant and J. B. McCreary and Company of Atlanta are the engineers who are making specifications and plats of the system and the work proposed.

CHICAGO HEIGHTS, ILL.—An ordinance introduced in the Council creates "the department of electricity" of the city government, and provides for the appointment of a head thereof, who shall be an electrical engineer, or a practical electrician with five

years' experience. A schedule of rates is fixed by the ordinance, and there are regulations concerning the issuing of permits, etc. On motion, the ordinance was held over to the next committee meeting.

KENDALLVILLE, IND.—The gas and light plant recently constructed by the Fort Wayne General Construction Company has passed into the hands of the Indiana Fuel and Light Company as the operating company. S.

VIRGINIA, MINN.—The Virginia Water and Light Company is erecting a fireproof brick power house and will install new fire pumps and electrical machinery. The total cost of the improvements will amount to $75,000. C.

LITTLETON, N. C.—The Panacea Springs Automobile and Electric Transfer Company has been chartered, with $125,000 authorized capital, to carry passengers and baggage from this town to Panacea Springs. Eugene Johnston is interested. L.

TOLEDO, OHIO—The Lake Shore Electric has made a proposition to the city of Fremont, Ohio, whereby it will expend $25,000 in improvements in consideration of an extension of its franchises. The proposition includes the paving of portions of State and Arch streets. H.

BELLINGHAM, WASH.—The North Coast Mining and Milling Company has appropriated 8,000 cubic feet of water per second from the Skagit River in Whatcom County. Water will be carried in flumes, pipe lines and tunnels to a point near Red Hill, where a power plant will be installed.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company is installing four 440-horsepower B. & W. boilers, with corresponding six-retort Taylor stokers, which they will operate at practically 900 horsepower normally. These boilers will, during a peak load, probably be run at about 1,200 horsepower.

HARTFORD CITY, IND.—The Hartford City Lighting Company announces that it will erect and equip a large central-station plant at this place and will generate light, heat and power for transmission to Upland, Eaton, Millgrove, Redkey and Ridgeville in addition to other towns and cities. Estimated cost of the plant is $75,000. S.

TOLEDO, OHIO—W. E. Richards has succeeded Charles R. McKay, resigned, as superintendent of light and power of the Toledo Railways and Light Company. Mr. Richards has been connected with the Toledo company for the past eighteen years, for the past several years holding the position of superintendent of the electrical department. H.

BERN, KAN.—The electric-lighting plant at Bern, Kan., owned by Ernest Gerber, was destroyed by fire and will be rebuilt at once. Mr. Gerber is in the market for an eight by ten or nine by ten high-speed, second-hand engine, and a twenty-kilowatt alternator, or an engine of the same size, direct-connected with a 110-220-volt three-wire unit.

BALTIMORE, MD.—Negotiations are pending between the Baltimore & Ohio and the United Railways Company, with the view of leasing the power house of the United, at Light and Heath streets. If the negotiations are successful, the Baltimore & Ohio will equip and use the power house as a supplemental station to its own power plant in Camden yards.

JOLIET, ILL.—The Economy Light and Power Company, which furnishes power for illumination throughout Joliet and is extending its lines in many directions, has just closed a contract with the village of Frankfort for supplying power to that town for lighting purposes. The line will pass through New Lenox and the work on its construction will be started at once.

FORT WAYNE, IND.—The City Council has been asked for an appropriation of $17,000 for electric-light betterments and extensions. The municipal lighting plant does not extend to the streets and residences on the outskirts of the city and there is a general complaint, as it is claimed the streets should be adequately lighted before experimenting with commercial lighting. S.

NEW YORK, N. Y.—The New York and Queens Electric Light and Power Company stockholders have failed to authorize the issue of $25,000,000 bonds proposed last April. They were to vote on the proposition by mail, but the company did not receive the required number of assets. At the annual meeting of the New York & Queens Electric Light and Power Company directors were re-elected.

KENNETT SQUARE, PA.—A receiver has been appointed for the Kennett Electric Light, Heat and Power Company. The company has been in financial straits for some time. Ralph Rhoads, the manager, issued a letter a few days ago charging gross criminal misrepresentation and mismanagement upon the part of those financing the company. He says there are $165,000 first-mortgage bonds, $300,000 of stock, $27,000 overdue notes, $3,000 unpaid bills and $1,000 in unpaid salaries against the company. The interest on the bonds was never earned, but paid out of receipts of stock sold, and that if the plant was put up at a forced sale today it would bring less than $50,000. The plant was built by local capitalists several years ago and has changed hands three or four times since then, being now said to be in control of the United Public Service Corporation, with headquarters in Philadelphia.

THOMASVILLE, N. C.—Mr. M. F. W. Bryant, Boston, Mass., has been elected superintendent and general manager of the Thomasville Light and Power Company for the ensuing year. The company is already finding a rapidly growing clientele, and is lighting the town and furnishing power for manufacturing plants. Mr. C. E. Leak, of Greensboro, was elected secretary and treasurer of this company. L.

SAN MARCOS, TEX.—The City Council of this city has agreed to grant an additional twenty-year franchise to the San Marcos Electric Light Company, their franchise having recently expired. This was done on an agreed basis between Victor M. Brooks of Austin and Will G. Barber of this city, attorneys for the light company, the attorneys agreeing to recommend same to the company to acceptance.

TOLEDO, OHIO—The Springfield Light, Heat and Power Company, of Springfield, Ohio, has submitted a proposition for a new franchise, although the old contract still has two years to run. In consideration of a ten-year agreement, it offers to make a reduction of fifty cents per lamp for each ten lights added to the 415 to be installed, including the 29 donated, until the rate has been lowered to fifty-eight dollars per year. H.

RALEIGH, N. C.—Following an act of the recent state Legislature requiring all steam-railroad engines to be fitted with electric lights, the representatives of the Norfolk & Southern Railroad recently appeared before the Corporation Commission, asking that their line be totally exempted from this rule. The road claimed that it made few runs at night, and that there was little need of headlights. The Commission reserved decision. L.

WASHINGTON, D. C.—The Rosslyn Electric and Gas Company, Rosslyn, Alexandria County, has been granted a charter by the state corporation commission, with a maximum capital stock of $50,000 and a minimum capital stock of $25,000. The objects are to operate a gas and electric-light plant. The following are named as officers: M. E. Church, president, Falls Church; G. H. Rucker, vice-president, Rosslyn; T. J. King, secretary, Georgetown, D. C.

GRAND JUNCTION, COLO.—A consolidation has been effected whereby the Grand Junction street railway and electric lighting plant, the gas plant and the Grand Junction Ice and Storage Company comes under one management. The cash consideration is $400,000. The purchasers are Charles McNeill, Thomas E. Curtin and other millionaires of Colorado Springs. It is understood that between $600,000 and $800,000 will be expended in the next year for improvements.

SAN FRANCISCO, CAL.—The final payment of approximately $1,000,000 was made this week by representatives of the California-Nevada Electric Company to the Fleishhacker interests for their Truckee River electric holdings. The property transferred includes two power plants and a distributing system carrying power into Reno, Carson, Virginia City and other towns. The new owner, under the management of W. P. Hammon, will extend the distributing system at a cost of about $1,000,000.

TOLEDO, OHIO—Plans are on foot for the lifting of the receivership of the Toledo Urban and Interurban line. A meeting will be held on August 6, with this end in view. Arrangements are also being made to increase the preferred stock of the company to $750,000. It is also probable that the matter of extending the Toledo, Bowling Green & Southern to Kenton and possibly to Columbus. The promise is made of a direct line from Toledo to Cincinnati, by way of Columbus, within eighteen months. H.

SAN FRANCISCO, CAL.—The directors of the Pacific Gas and Electric Company, at a meeting on July 29, decided to offer the preferred stockholders, in lieu of preferred dividends amounting to $2,000,000, common stock to the amount of $5,000,000. This will put out the common stock at forty per cent of the par value, the price on the local market having been forty-four in recent sales. It was announced at the directors' meeting that the unifying and refunding bond plan had resulted in the placing of $5,000,000 in bonds with a New York house.

RICHMOND, VA.—The application of the Virginia Railway and Power Company, successor to all the street-railway, lighting and power companies in this city, Petersburg, Manchester, and in Henrico, Hanover, Dinwiddie and Chesterfield counties, has been received by the Corporation Commission. The minimum capital is $9,000,000 and the maximum is $12,500,000, the new company to take charge July 1, with principal offices in this city. Frank Jay Gould, Tarrytown, N. Y., is named as president of the board, in the petition; president, William Northrop, of Richmond; vice-president and general manager, Henry Anderson, Richmond; secretary and treasurer, Guy Phillips, New York; the directors include the above-named officials and Messrs. C. S. Whelen, Phila-

delphia; Edward Gould, Dobbs Ferry, N. Y.; Percy M. Chandler, Philadelphia; R. Lancaster Williams, Richmond; Fritz Sitterding, Richmond. This ends a long-drawn fight between the Fisher and Gould interests, and the transfer of the property is by order of the United States Court, which confirmed the auction sale to the new owners. C. B. Buchanan will be general manager of street railways, and Geo. M. Whitfield, general manager of the light and power departments. L.

TRENTON, N. J.—Articles of incorporation have been filed by the Union Railway, Gas and Electric Company, which has an authorized capital stock of $18,000,000. Of this $12,000,000 is cumulative stock bearing six per cent cumulative dividends, and $6,000,000 common stock. The company is to build and operate railroads, electric-light and power plants, gas plants and steam heating and supply plants. The charter was recorded in Camden by the Corporation Guarantee and Trust Company. The incorporators are F. H. Hansell, John A. MacPeak and Joseph F. Cotter.

ALEXANDRIA, VA.—Recent rumors that Baltimore and Washington capital was seeking to buy the Alexandria Electric Company franchise and rights have been confirmed, following a meeting in Philadelphia at which new officers were chosen. Thomas C. Coleman, of Cockeyesville, Md., was made president; H. P. Lucas, of Baltimore, secretary and treasurer, and F. R. Weller, of Washington, D. C., general manager. Among the plans of the new holders is the doubling of the Alexandria plant's capacity, and the institution of a campaign for more business in house lighting, and power and heating service. L.

ATLANTA, GA.—The Council committee on electricity has voted favorably on the application of the Central Georgia Power Company for a franchise to sell power for lights and manufacturing purposes, etc., in this city. The application is copied from the franchise recently granted the Piedmont Power Company, and W. J. Massee, president of the Central Georgia company, states that the sum of $1,500,000 has already been expended in the work of construction, and a similar amount is in hand in cash for further prosecution of the work as needed. L.

HAZLETON, PA.—The Consumers' Electric Light and Power Company, the McAdoo Electric Company, Harwood Electric Power Company, Nescopeck Township Electric Power Company, Sugarloaf Township Electric Company, Black Creek Township Electric Company, Kline Township Electric Company, Union Township Electric Company, Rush Township Electric Company and Rahn Township Electric Company have all been merged under the name of the Harwood Electric Company, the power house of which is now nearly completed, and which will supply current throughout the territory of Hazleton and its vicinity.

SALISBURY, N. C.—Encouraging reports continue to emanate from here as to the likelihood of the old Whitney Reduction Company's mammoth electrical development being resumed soon, following a long shut-down due to litigation. Argument has been concluded in all remaining exceptions in the noted Whitney case, before Special Master A. H. Price, and final argument will be made before Federal Judge J. C. Pritchard at Asheville before the end of the month. It is also understood that arrangements are assured for the further financing of the project, on which many thousands have been expended already, for the development of one of the largest single electric plants in the southern country. L.

GRAND JUNCTION, COLO.—As the result of the consolidation effected recently in Colorado Springs of the Grand Junction Street Railway Company and the Grand Junction Electric, Gas and Manufacturing Company, twenty miles of interurban electric lines will be built in the Grand Valley during the next two years. The holding company is to be known as the Grand Junction & Grand River Valley Railway Company, and Thomas E. Curtin is to be president. The Grand Junction Electric, Gas and Manufacturing Company was taken into the new corporation at a valuation of $500,000, and will be at once enlarged to furnish adequate power both for lighting and operating the interurban system.

BROOKLINE, MASS.—A substantial cut in the price of electricity has been announced to the Brookline selectmen in a letter from the Boston Consolidated Gas Company. The cut is in accordance with an agreement made between the company and the committee appointed in 1907 to consider the need of a municipal lighting plant. An additional cut is promised in July of next year. Under the new terms the maximum rate is from sixteen to fourteen cents per kilowatt-hour. The contract rate is from eighteen, eight and five cents per kilowatt-hour to sixteen, seven-and-one-half and five cents per kilowatt-hour, under the rule of primary, secondary and tertiary charges. The cost per year for street arc lamps is to be $110 each, as against the old cost of $124.10. However, the communication states that the rate for arc lights is made only under consideration of a five-year contract. The town has 261 arc lights, of which seventeen are in parks. Little use is made of incandescent street lights; instead, the town has 918 Welsbach lights, of which 781 are gas and 137 naphtha lights. It is thought, however, that the new rate for electricity will offer such inducements that the gas lamps may be superseded by incandescents.

COLORADO SPRINGS, COLO.—The organization of the Automatic Light Company, composed mostly of Colorado Springs men, and incorporated for $1,000,000, has been completed, with the election of the following officers: President, C. S. Gambrill, of the El Paso Ice and Coal Company; vice-president, W. B. Dempster, president of Dempster & Place, glove manufacturers, of Gloversville, N. Y.; secretary and general manager, Taylor J. Downer, Colorado Springs; treasurer, E. G. Davis, of the Elite Laundry Company. These officers, with E. F. Downer, of this city, form the board of directors. T. J. Downer is the inventor and patentee of the signal light for electric cars, which has been tested on the street cars in this city, and will be installed on several of the electric cars in Denver.

RICHMOND, VA.—The proposed municipal lighting plant, for which large appropriations have been made, will, in all probability, require considerably more money than was first anticipated, before the system is fully provided for. The first additional matter comes in the form of a request for the number of lights that will be required to light all of the alleyways of the city, and cost of the same. The city will be compelled to build a complete system of street electric lines to replace the old system, which has been used under lease from the old Virginia Passenger and Power Company. The city has declined to purchase these lines, poles, wires, etc., desiring to put in a new system. To date the money available by bond issues is, $250,000 for construction purposes and $100,000 for machinery in the lighting power plant. L.

CHARLOTTE, N. C.—A ten-year contract has just been agreed upon by the city executive board and the Southern Power Company for the furnishing of not less than 300 arc lights for the period named. The first 250 lights will be paid for at the rate of $56 per annum per light, and all lights over 250 to be supplied at $50 per annum. This is claimed to be the cheapest lighting that any city of the population of Charlotte enjoys in the south. The annual light bill for approximately 350 lights is $19,000. The city has the privilege of buying the lights at the end of five years, and there are other clauses in the contract to protect the interests of both city and company. In the event that the city should desire to purchase the system at the end of five years, the company reserves the right to charge $60 instead of $56 for the first 250 lights and $54 instead of $50 for all over 250 lights. L.

PHILADELPHIA, PA.—The Philadelphia Electric Company intends greatly to extend its field, and has contracted to furnish current to the recently organized Delaware County Electric Company, which supplies electricity to most of the towns in Delaware County. According to the arrangement made, the Philadelphia Electric will furnish current for the territory between Philadelphia and Media, including the towns of Swarthmore, Morton and Wallingford. The distribution will be made by the Delaware County Electric Company. The latter corporation is the result of the amalgamation of three separate Delaware County plants, which will now be closed. The Delaware County Company will now purchase all its power from Philadelphia Electric. The latter company has agreed not to sell its power to any other consumer in the territory served to the Delaware County Company, assuring the new corporation a monopoly.

BOONE, IOWA—The City Council recently passed, by unanimous consent, to the people for popular vote, a franchise which will mean the rejuvenation of the public utilities of the city. This franchise, which is termed the Hughes-McBride franchise, would mean, it is rumored, further interurban extensions and low rates for light and power. The power rate, which compares favorably with the rate in any city in Iowa, and which should be a boost for manufacturing concerns, is as follows: Forty kilowatt-hours per month, nine cents per kilowatt-hour; forty to fifty kilowatt-hours per month, eight cents per kilowatt-hour; fifty to 100 kilowatt-hours per month, seven cents per kilowatt-hour; 100 to 200 kilowatt-hours per month, six cents per kilowatt-hour; 200 to 300 kilowatt-hours per month, five cents per kilowatt-hour; 300 to 400 kilowatt-hours per month, four cents per kilowatt-hour, and over 400 per month, for three cents per kilowatt-hour.

PROVIDENCE, R. I.—Another big steam turbine is to be placed in the power house of the Narragansett Electric Lighting Company. It is stated that all the Narragansett steam engines as fast as worn out will be replaced with turbines and that the Westinghouse-LeBlanc condenser, which was applied to the first turbine, has proved to be reliable and will be used with the turbine just ordered. Turbines of the Parsons type also have been recently selected in preference to reciprocating engines by the Atlantic Mills, the Sea View Railroad, the Manville Company, the Hamlet Textile Company, the North Scituate Cotton Mills, the Royal Weaving Company, Glenlyon Dye Works, the Lowland Worsted Mill, the Aldrich Manufacturing Company, and by F. P. Sheldon & Sons for the Lyman Mills, Holyoke, and the Erwin Mills, Durham, N. C., and by Knight C. Richmond as consulting engineer for the Dartmouth Mill, New Bedford.

ELECTRIC RAILWAYS.

(Special Correspondence.)

MINNEAPOLIS, MINN.—Work has been started on the survey for the electric line to Anoka, Minn. C.

MOSCOW, IDAHO—A franchise has been granted for a street railway to the Spokane & Inland Empire Railroad Company.

MISSOULA, MONT.—A. H. Withey announces that the Clark company will shortly commence construction work on the electric line to the fort. C.

HELENA, MONT.—Former Governor Hauser states that funds have been obtained for the construction of the Butte and Helena electric line. C.

SALINAS, CAL.—The Board of Supervisors has granted to H. R. O'Bryan the electric-railway franchise in this county, recently applied for by him. A.

SANTA BARBARA, CAL.—The City Council has adopted a resolution awarding a franchise for a trackless trolley line to the Pacific Improvement Company. A.

BUTTE, MONT.—Manager Wharton of the local street-car company announces that his road will make extensive improvements and extensions to its system this year. U.

MACON, MO.—Articles incorporating the Hannibal & Northern Missouri Railroad Company, capitalized at $2,000,000, have been filed. The line is to be operated by electricity.

HOUSTON, TEX.—The Marshall Traction Company of Marshall, capital stock $25,000, has been incorporated. Incorporators: M. Turney, F. H. Prendergast, F. A. Austin and others.

BELLINGHAM, WASH.—The Whatcom Railway and Light Company will extend its line a distance of 5,980 feet. The improvement is known as the Happy Valley extension and will cost $12,000. U.

MICHIGAN CITY, IND.—The Chicago South Shore Electric Railroad Company is settling claims growing out of the Chesterton wreck. It estimates that the aggregate will reach from $80,000 to $100,000. S.

CHARLOTTE, N. C.—The Piedmont Carolina Railway Company has secured a franchise for the construction of an interurban electric line from Salisbury to Concord and an urban system for the latter city.

BOONE, IOWA—The coal mines near Ogden have been sold to the Fort Dodge, Des Moines & Southern Interurban, being the biggest coal deal in years here. The company will construct a track to the new property.

INDIANAPOLIS, IND.—The Indianapolis & Beech Grove Electric Railway Company is preparing to let the contract to construct eight miles of road, to connect Beech Grove, where the Big Four shops are located, with the city. S.

WAUSAU, WIS.—The Wisconsin River Traction and Power Company has commenced the construction of a dam across the Wisconsin River at Trappe, which is taken as an indication that the electric road to Merrill will be built. C.

AUGUSTA, ME.—The Lewiston, Augusta & Waterville Street Railway Company plans to run a line of freight cars on its lines in the rural districts, which will give the farmers better facilities for transporting their products to market.

MOUNT VERNON, IND.—Plans have been formulated for the construction of an interurban line from this city to Burt Prairie, Fairfield and Cormill, Ill. George W. Burnes, president of the Burt Prairie Bank, is at the head of the project. S.

BLUFFTON, IND.—The Bluffton, Geneva and Celina Traction Company has been granted a fifty-year franchise right to enter the city, by the City Council. The officials of the company agree to have the road in operation within one year. S.

EVANSVILLE, IND.—The City Council has granted the Evansville & Newburg Electric Railway Company a franchise to haul freight through the streets. This privilege was withheld until the business interests of the city demanded that the right be granted. S.

LAPORTE, IND.—Interest has been revived in the construction of an electric line between this city and Logansport, passing through Knox, Bass Lake and Winamac—connecting three county seats. A meeting was held in this city July 2, and eastern capital was represented. It is proposed to construct the road next year. S.

SPRINGFIELD, ILL.—The Belleville and Mascoutah Traction Company has been licensed to incorporate. The capital stock is nominally $150,000, and the principal office is Mascoutah. The road is to be constructed from Belleville to Mascoutah. The incorporators and first board of directors are: Emil J. Kohl and Adolph Knobeloch, both of Belleville, and Gust. J. Sheve, E. E. Hagist and Peter W. Lill, all of Mascoutah.

MARSHFIELD, ORE.—J. M. Blake, who, it is understood, is representing eastern capitalists, has applied for a franchise to construct and operate an electric railroad running on certain streets here, and has also applied for a franchise to operate in North Bend. U.

EVANSVILLE, IND.—The Indiana Railroad Commission has issued an order requiring two interurban lines, the Evansville & Newburg and the Evansville Terminal Railroad companies, to construct a physical connection at Newburg in order that an interchange of freight may be maintained. S.

MINERAL WELLS, TEX.—It is stated that Little Rock capitalists, headed by the Kempner brothers, have acquired the Mineral Wells electric system and its appertaining properties from the Jones-Bomar interests of Fort Worth. This is regarded as meaning early re-operation of the line.

MILES, WASH.—The Big Bend Transit Company, which holds the power site at the narrows below Fort Spokane, proposes to build an electric line along the Spokane River from Spokane to the Columbia River steamboat landing, above the mouth of the Spokane River, and use the narrows for a power site. U.

KOKOMO, IND.—C. C. McFann, a local capitalist, is at the head of a company seeking the right-of-way for a traction line from this city to Young America—a distance of sixteen miles. The road will be constructed through fertile farm lands, hitherto void of railroads, and connect a number of prosperops villages. S.

EUGENE, ORE.—Vice-President and Manager A. Welch of the Portland, Eugene & Eastern Railway Company, which operates the electric lines in Eugene as well as the interurban lines out of this place, announces that the company will erect this year a large power house at Martin's Rapids, thirty miles from Eugene. A.

LA CROSSE, WIS.—The La Crosse Water Power Company has secured an option on all the properties of the La Crosse Cty Railway Company. The latter company has recently issued $400,000 bonds, which have been taken up by the National Bank of La Crosse, to retire present bonds and make improvements in the service. C.

MILES, WASH.—The Big Bend Transit Company, which is to build an electric railway from Spokane, Wash., to the Columbia River steamboat landing, above the mouth of the Spokane River, is preparing to put in a sixty-foot dam and a power house at the Narrows. Engineer L. F. McCoy has just completed a survey of the river at the dam site. A.

KINGSTON, N. Y.—A thirty-mile trolley line will be built in Rockland. It will begin at Tappen and go as far north as Stony Point. It will do much to develop Rockland County. The cost will be $2,500,000. It is proposed to extend a trolley line along the west bank of the Hudson until it reaches the state capital by way of Kingston, Saugerties and Catskill.

DES MOINES, IA.—Incorporation papers for the Iowa & Omaha Short Line, giving the capital stock at $100,000,000, have been filed in the office of the secretary of state. The line will be operated electrically and will be 140 miles in length, terminating in Douglas County, Nebraska. John A. Holmes of Pierre will be in charge of the home office, which will be in Pierre.

LOGANSPORT, IND.—The Fort Wayne & Toledo Electric Company has announced that the actual construction of a line from Fort Wayne to Toledo will be commenced as soon as the requisite amount of stock has been subscribed for. The line, when completed, will be the connecting link between this city and Toledo, and will traverse a prosperous and growing country.

PONCE DE LEON, PORTO RICO—At a special meeting of the shareholders of the Porto Rico Railway Company, held in New York July 8, the shareholders authorized an increase in the capital stock from $3,000,000 to $3,500,000 by the issue of $500,000 preferred stock at par. The company states that this capital is necessary to take advantage of the satisfactory franchises secured by the company for double-tracking and for the extension of its lighting lines to cities and towns in the eastern part of the island.

WINSTON, N. C.—An announcement of more than ordinary interest is made to the effect that an interurban electric line will be built from this city to Salisbury, forty miles southwest, and to High Point, on the Southern Railway, and along a very heavily traveled part of the steam railway. The chief promoter is T. H. Vanderford, of Salisbury. It is said that the principal rights-of-way were secured already. A supplemental line, that from Salisbury to High Point, thirty-six miles in length, paralleling the route of the main line of the Southern Railway, which has been under consideration for some years, is likewise receiving a good deal of attention, while the Salisbury-Winston cross-country line is being promoted. The fact that this line is now materializing follows the announcement of the building of the "Southbound" steam railway from Winston, crossing the above-mentioned line from Salisbury, to High Point and continuing through the center of the

state, is perhaps of some significance relative to the electric-railway announcement. Furthermore, Mr. Vanderford has sought an extension of time from the town of Concord, thirty-four miles southwest of Salisbury, and has put up $1,000 forfeiture with the Concord officials to begin work inside of sixty days on a local electric system. Mr. Vanderford declares that work will be begun immediately in Concord. It is stipulated in the franchise that three miles of track are to be completed and in use within two years. L.

ST. JOSEPH, MO.—The Engineering Construction and Securities Company, Chicago, Ill., was recently given a contract for the engineering and construction of an interurban road from Creston, Ia., to Des Moines, Ia., running through Macksburg and Winterset. The engineering corps will be put in the field to make the survey at once. Any information desired in regard to this proposition may be secured by addressing C. B. Judd, chief engineer, at Creston, Ia., or C. A. Ross, president, Engineering and Securities Company, Chicago.

SAN JOSE, CAL.—The Peninsula Railroad Company, one of the Harriman Southern Pacific properties, recently incorporated in San Francisco, has filed its articles of incorporation here preliminary to the taking up of active work in Santa Clara County. The roads already owned and in operation by the company include the San Jose and Los Gatos electric line, the old Peninsular electric line and the San Jose and Santa Clara line. New lines and extensions to old ones are planned which will bring the total mileage up to 220 miles. A.

AUSTIN, TEX.—The governor has requested the Attorney General's Department to prepare the form for the state railway bonds, as they will be issued under act of the last legislature. The outstanding bonds, aggregating $125,000, are to be refunded and $50,000 additional bonds are to be issued to complete and equip the state railway, to be operated from Rusk to Palestine. The original $150,000 of State Railway bonds provide for one bond of $7,500 to mature each year, and one has matured and been taken up. The next will mature on December 1, 1909. The bonds will be refunded and the school fund secure the entire issue.

McKEESPORT, PA.—A company has been organized to build a trolley line from Dravosburg to Duquesne. The distance will be about three miles and will cut the present route in half. Business men in Duquesne, together with a few outside capitalists, are financing the company, which will be known as the Duquesne and Dravosburg Street Railway Company. The officers of the company are: President, Fred W. Scott, of Duquesne; vice-president, J. C. Cato, of Aliquippa; secretary, T. F. Vankirk, of Coraopolis; treasurer, A. J. Krill, of Aliquippa; board of directors, William J. Leader, J. W. Speering and M. G. Conlin, of Duquesne, H. C. Purdy, of Coraopolis, and Charles McGinley, of Indiana.

JOLIET, ILL.—The Chicago, Ottawa & Peoria Railway Company is about to increase the capacity of its power plant at La Salle, and if terms can be made with the commissioners of the I. & M. Canal the power line may be built along the canal from Split Rock to Joliet. At the present time the company's pole line between La Salle and Split Rock is constructed along the towpath, and if arrangements can be made the line will be extended to Joliet. This arrangement will enable the company to compete with the W. D. Boyce Company, which has a pole line on the other side of the canal. This line is completed from Morris to Ottawa and the effort is being made to extend it to La Salle.

CHARLOTTE, N. C.—The Charlotte Electric Railway Company has completed the third public park, within three miles of the center of the city, since its organization fifteen years ago. The newest pleasure resort is Lakewood Park, where large sums have been expended on an artificial lake, boating facilities, pavilion, dance halls, etc. The company has established an up-to-date service with double tracks to the new park, and has proven of great value to the city in furnishing the only suburban parks which the city possesses. It is only a question of time, perhaps less than two years, before lines are built to the Catawba River, twelve miles to the west, where another pleasure park and resort will be constructed on liberal and expensive lines by this progressive concern. L.

PHILADELPHIA, PA.—George H. Earle Jr.'s plan to finance the Interstate Railways Company has been approved by the board of directors. The plan, in a word, proposes that the four per cent bonds of the corporation shall be deposited in trust, the income to be used for betterment, and if any money is left it shall go toward paying the interest. What then is lacking is to be obtained by issuing six per cent scrip. Bondholders who prefer cash will receive it. The scrip they refuse will be sold and the receipts placed in the company's treasury. Bondholders are asked to signify their assent to the plan and to deposit their bonds. The plan is signed by John C. Bell, James F. Sullivan, Richard Y. Cook, F. W. Roebling, William R. McIlvain, Holstein DeHaven, Richmond L. Jones and George H. Earle, Jr., chairman.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

LAKE CITY, ARK.—The People's Telephone Company has been incorporated with a capital of $10,000.

WINNSBORO, LA.—The Winnsboro Telephone Company has been incorporated with a capital stock of $25,000.

TWO RIVERS, WIS.—The West Shore Telephone Company has been incorporated with a capital stock of $6,000.

LYONS, NEB.—The Lyons Independent Telephone Company has been incorporated with a capital stock of $25,000.

PHILADELPHIA, PA.—The Citizens' Telephone Company, of Kent County, has been incorporated with $30,000 capital.

ANADARKO, OKLA.—The Anadarko-Southern Telephone Company has been incorporated by J. E. Stalder and others.

LAKE CITY, ARK.—The People's Telephone Company has been incorporated in Lake City with a capital stock of $10,000.

SPIRIT LAKE, IOWA—The Midland Telephone Company has completed arrangements for the erection of an exchange building. C.

READOUT, OKLA.—The Stockholm and Southwestern Telephone Company has been incorporated by J. W. Williams and others.

BELLINGHAM, WASH.—The American District Telegraph Company is preparing to put in a burglar-alarm and messenger-call system in this city.

SAN FRANCISCO, CAL.—The Pacific States Telephone and Telegraph Company will expend $11,000 in the improvement of its system at Watsonville.

GRAFTON, N. D.—Farmers who reside in Grafton and Fertile townships have organized a co-operative telephone company, with the following officers: A. Midgarden, president; Thomas Thorson, secretary. C.

MARTINSVILLE, IND.—The Martinsville Telephone Company announces that it will install an automatic system in its new exchange building when completed, and also modernize and extend the entire plant. S.

WATERLOO, IOWA—The announcement is made that a deal has been consummated whereby the Corn Belt, Cedar Rapids and Marion and Johnson County telephone companies will pass into the hands of the Bell people. C.

OMAHA, NEB.—The Nebraska Securities Company has been incorporated by Albert E. Wilson, Charles P. Flynn, F. M. Phipps and others, with a capital of $750,000, to take over the Independent Telephone Company. C.

DEFIANCE, OHIO—The Northwestern Telephone Company has increased its capital stock from $60,000 to $100,000. H. B. Tenzer is president of the company and W. G. Lehman, secretary. A highly prosperous condition is reported. H.

COUNCIL BLUFFS, IOWA—A paid-up capitalization of $14,500,000 and an authorized capital stock of more than $20,000,000 is represented in the functionary consolidation of the five western Bell telephone companies to be operated from Omaha.

BALTIMORE, MD.—The Maryland Telephone and Telegraph Company has given notice that it will on September 1 redeem all general mortgage bonds outstanding against the company. They will be paid at the office of the Central Trust Company, of Baltimore.

OMAHA, NEB.—The Nebraska Securities Company, a corporation to take over the Independent Telephone Company, has filed articles of incorporation. The new company is to have a capital stock of $750,000, which the articles say shall be paid up on issuance.

TOLEDO, OHIO—The Arcade Mutual Telephone Company, of Findlay, Ohio, has been incorporated, with an authorized capital stock of $10,000. The incorporators are Sherman Huffman, Wm. H. Dilley, E. E. Bish, G. W. Dick, A. L. Anderson, E. T. Dailey and H. J. Harkness. H.

DES MOINES, IOWA—The Bell Telephone Company has strengthened its hold in Iowa. Minneapolis brokers acting for the company have purchased control of the Cedar Rapids and Marion Telephone companies, the Marion Telephone Company, the Corn Belt Telephone Company, of Waterloo, and the Johnson County Telephone Company. The Bell Company is making rapid strides in Iowa and is forming a great state telephone service.

WINSTON, N. C.—The Southern Bell Telephone Company has authorized and begun work on a toll line from this point to Elkin; also a long-distance line from Morganton to Black Mountain, and thence to Asheville, thus completing a continuous stretch of long-distance lines from Charlotte, via Statesville, to Asheville, 150 miles in length. The two lines mentioned place in direct communication with all southern cities and the cities of the north scores of lumber, mining and other industries of the western part

of the state. Some seven of eight mountain counties and probably forty mountain towns and villages will be affected by the various extensions and sub-leases, whereby long-distance service is given, or made available, for subscribers to local exchanges or to those located on the trunk lines of the long-distance service. L.

CORYDON, IND.—At the annual meeting of the directors of the Eureka Telephone Company it was decided to extend the lines and enlarge the capacity of the plant. The following officers were elected: President, Alonzo Cunningham; vice-president, Elias Shields; secretary, H. P. Beanblossom; treasurer, D. C. Davis. S.

NEW YORK, N. Y.—The New York Telephone Company, which operates in Yonkers, has taken over the Westchester division of the Hudson River Telephone Company, which embraces towns from Peekskill to Croton, and from Briarcliff to Brewster. Several towns on the west side of the river, including Haverstraw, Nyack, Tappan and Spring Valley, also supplied by the Hudson River company, are absorbed. There are about 5,000 instruments.

HOUSTON, TEX.—Plans for the new South End exchange to be erected by the Southwestern Telegraph and Telephone Company have been perfected. The South End exchange will cost in the neighborhood of $50,000 or $60,000 when it is fully equipped and it is stated that work will be started on it as soon as the detailed specifications can be worked out and bids secured. It will be a fireproof building and the equipment alone will cost approximately $30,000.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company will spend $1,000,000 for improvements in the territory which it covers within the next year. This includes the Minneapolis, St. Paul and Duluth systems, together with the network of toll lines and stations connected with these principal exchanges. The announcement has been made by Casper E. Yost, of Omaha, president of the company and head of the five middle western Bell concerns.

ORANGE, TEX.—The Orange Telephone Company exchange has been sold by Receiver P. M. Shingle to a committee of bondholders, represented by George D. Crane of Kenton, Ohio. The sale will have to be confirmed by the federal court and after sixty days' time there will be a reorganization of the company and improvements can be made. The company has been short a large number of phones for several months and nothing could be done, because the business was in the hands of a receiver.

WEBSTER CITY, IA.—E. H. Martin, well-known telephone man and capitalist, has announced his intention of leaving Webster City. He will move to Minneapolis. The Martin telephone plant here, which is capitalized at $200,000, will be sold. A plan is now on foot to reorganize the company and dispose of it to a number of prominent independent Iowa telephone men. C. P. Holdeegle, of Rockwell City, of the Iowa Telephone Clearing House directorate, has been in the city looking over the plant and it is likely that the reorganization will take place under his supervision.

NEW PUBLICATIONS.

UNIVERSITY OF ILLINOIS BULLETIN—The University of Illinois has issued its 1909-1910 circular of information of the College of Engineering, a 101-page book containing the University Calendar, particulars of the College of Engineering, courses of study, engineering experiment station, etc. The work is provided with a copious index.

ANNUAL REPORT OF THE COMMISSIONER OF PATENTS—The Annual Report of the Commissioner of Patents for 1908 has just been issued. It shows total receipts, from all sources, of $1,896,847.67, total expenditures of $1,712,303.42, leaving a surplus of $184,544.25 for the year. Of the 61,475 applications for patents, 33,682 were granted. There were 12,208 applications for trade-marks, labels and prints, 6,029 of which were granted.

MAY BULLETIN OF THE BUREAU OF STANDARDS—The *Bulletin of the Bureau of Standards* for May contains quite a number of articles of much interest to electrical men. Among these are: "The Testing of Transformer Steel," by M. G. Lloyd and J. V. S. Fisher (this paper is the one recently presented before the annual convention of the American Institute of Electrical Engineers at Frontenac); "A New Method for the Absolute Measurement of Resistance," by Edward B. Rosa; "The Theory of Coupled Circuits" and "The Coefficient of Reflection of Electrical Waves at a Transition Point," by Louis Cohen; "A Volt Scale for a Watts-per-Candle Meter," by Herbert E. Ives; "A Tungsten Comparison Lamp in the Photometry of Carbon Lamps," by Dr. Ives and L. R. Woodhull.

GROUNDED CIRCUITS AND ELECTROLYSIS—A reprint of an interesting article entitled "Grounded Electric Transmission and Electrolytic Corrosion," by J. Stanley Richmond, has been published by the *Canadian Engineer*, of Toronto, Canada. In this pamphlet of sixty-nine pages the author reviews at first the history and literature of the subject. With the aid of numerous diagrams several methods of testing grounded circuits are described, particularly the author's system of making elaborate measurements of track drops from a central point of a railway system. There is also a discussion of voltage contour lines and of rail bonding. The author concludes with a description of several methods for lowering the track drop. Throughout, this little booklet contains much valuable information on the subject of ground-return circuits and should prove interesting reading for electric-railway managers and engineers.

SUPERVISION OF STREET RAILWAYS IN ENGLAND AND PRUSSIA—This is a reprint from the annual report of the Public Service Commission for the First District of the State of New York for the year ending December 31, 1908. It opens with a summary of state prevention and franchise procedure in the two countries, an account of "prevention versus correction," a law-court review, and an article on metropolitan problems. Following the summary are two lengthy articles, both by Robert H. Whitten, the first on "Supervision of Street Railways in England" and the second on "Supervision of Street Railways in Prussia." The book concludes with "exhibits" containing a model form of regulations issued by the English Board of Trade for the equipment and operation of electric railways, a Board of Trade memorandum regarding details of construction and equipment of tramways and light railways laid on public roads (July, 1908), Prussian regulations for the construction and operation of street railroads with mechanical traction, regulations for the Berlin District (September 3, 1907), supplementing the latter, and lastly a model form of concession from the state for street railroads in Prussia.

BRIQUETTING TESTS—The Technologic Branch of the United States Geological Survey has issued Bulletin 385, on Briquetting Tests at the United States Fuel-Testing Plant, Norfolk, Va., 1907-1908, edited by Charles L. Wright (Washington, D. C., Government Printing Office, 1909). An official definition of briquetted or "agglomerated" fuel is given in this bulletin as "fuel made by pressing in molds a mixture of coal dust and small-sized pieces of coal or other fuel material and a binding substance which holds the particles together." It further goes on to say that the most common binder at present commercially available is a pitch made either from coal tar or water-gas tar, but other substances, such as starch, lime, sulphite liquor, etc., have been used with more or less success. The tests described are combustion, drop, tumbler, weathering, absorption and density tests. A detailed description is given of the English and American types of briquetting machines. A very complete bibliography pertaining to the subject is appended, and the bulletin is well supplied with illustrations. This is a most timely publication and will be heartily welcomed by all interested in this important subject, which is now attracting a great deal of attention in the United States, as it has already developed to a considerable degree in European countries.

PROPOSALS.

POST OFFICE, GONZALES, TEX.—The office of the Supervising Architect, Washington, will receive sealed proposals until 3 o'clock p. m. on August 5, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Gonzales, Texas, in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Gonzales, Texas, or at the Supervising Architect's office.

NEW MANUFACTURING COMPANIES.

SIOUX FALLS, S. D.—The Northwestern Electric Company has been incorporated, with a capital of $25,000, to handle electrical supplies.

NEW ALBANY, IND.—The W. J. Miles Casting Company has secured a site in this city and will erect and equip a plant to manufacture steel gears for electric cars, machine tool gears and high-grade iron castings.

HARTFORD, CONN.—The Lionell Manufacturing Company, of New Haven, has been incorporated with a capital stock of $50,000, to manufacture electrical toys. The incorporators, all of New York city, are Gustave K. Hartung, Joshua L. Cohen and Victor Scharps.

NEW YORK, N. Y.—The Electric Cigar Advertising Company has been incorporated to manufacture advertising devices and novelties, with a capital of $50,000, and the following incorporators: G. H. Schuler, Belleville, N. J.; S. I. Knight, and G. F. McKay, New York city.

INDIANAPOLIS, IND.—The National Creosoting Company has filed articles of incorporation, with a capital stock of $200,000. The company proposes to build, equip and operate a plant for the treating of railroad ties and timbers of all kinds. Alvin T. Hert, R. V. Look and H. W. Griffith, directors. S.

ALBANY, N. Y.—The Westinghouse Storage Battery Company, of New York, has been incorporated with the Secretary of State; capital, $1,750,000, $100 shares, of which $250,000 is six per cent preferred. The directors are: H. H. Westinghouse, Samuel B. Dusinberre. George C. Smith, H. Cool and John G. Greenburgh, of New York.

PERSONAL MENTION.

DR. E. P. ADAMS, assistant professor of physics at Princeton, has been made a full professor in that subject.

DR. JOHN C. SHEDD, of Westminster College, Denver, has been made professor and head of the department of physics at the University of Pittsburg.

PROF. E. F. NICHOLS, president-elect of Dartmouth College, has been made a doctor of laws by Colgate University, of which institution he was professor of physics from 1892 to 1898.

H. ALMERT, an engineer of long practice in Chicago, has been appointed manager of the department of examinations and reports of H. M. Byllesby & Company, with headquarters at Chicago.

CYRUS OSBORNE BAKER, the platinum importer, is in London, convalescing from a severe illness. He is accompanied by Mrs. Baker, and they will spend several weeks in Carlsbad before returning to New York.

E. M. BASSETT, of the New York Public Service Commission, is making a tour of inspection of the public service corporations in various cities, including Buffalo, Chicago, Milwaukee and St. Paul. He will be gone a month.

C. E. GROESBACK, of San Diego, Cal., has been elected a vice-president of H. M. Byllesby & Company, with headquarters at Tacoma, Wash., in charge of their interests on the Pacific Coast and in the states of Idaho and Montana.

CHARLES E. BURGOON, late assistant inspector of electric-light plants, United States Treasury Department, has been appointed assistant to W. A. E. Doying, inspecting engineer to the Isthmian Canal Commission, Washington, D. C.

W. R. THOMPSON, late of the Public Service Commission of New York state, and formerly with Westinghouse, Church, Kerr & Company, has been appointed assistant to the chief engineer of H. M. Byllesby & Company, with headquarters at Chicago.

R. F. SCHUCHARDT, of the Commonwealth Edison Company, and editor of the *Round Table*, the N. E. L. A.'s branch organ, is on a holiday trip through the East with Mrs. Schuchardt. After leaving Atlantic City, Mr. Schuchardt journeyed to Montreal, Que., and back again to Schenectady, then down the Hudson to New York, and will return home by way of Baltimore and Washington.

A. R. HALL, of the Capital Electric Company, of Denver, Colo., on returning from the convention of the American Institute of Electrical Engineers, at Frontenac, N. Y., stopped in Chicago last week to mingle with the local electrical men. He reports excellent business in the West. Denver's new "White City" is now illuminated entirely by Hall lamps, over 100,000 lamps being used.

H. B. MARSHALL, who has been for many years connected with the Chicago sales office of the Electric Storage Battery Company in the Marquette Building, has recently been appointed contract agent, in charge of that company's office at St. Louis in the Wainwright Building. Taliaferro Milton, formerly contract agent of the St. Louis office, has been appointed engineer of the Chicago sales office of the Electric Storage Battery Company.

F. W. WILLIS, formerly of the Commonwealth Edison Company's engineering department, has for five years been in India, where he is an operating engineer with the Canvery Power Scheme, Champion Reef, Mysore, India. He has splendid bachelor quarters and a retinue of servants to wait on him. Two years ago Mr. Willis enjoyed an accumulated vacation and visited his old friends in Chicago, traveling by way of Burma, China, Japan and Hawaii.

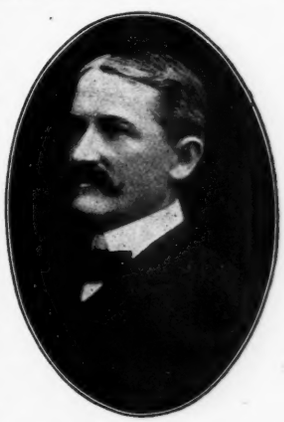
WILLIAM RUSSELL WILLCOX, chairman of the New York Public Service Commission, First District, sailed on the Mauretania last Wednesday and will be absent for about six weeks. During his absence Commissioner McCarroll will most of the time act as chairman. Mr. Willcox made the following statement: "The subway situation is now well in hand. We have increased the staff of engineers, so that plans for the proposed new routes may be drawn as quickly as possible, and the legal department is already at work on the forms of contract. The working out of these matters is now merely a matter of detail. They will proceed just as promptly with me in Europe as if I were here. When I return I expect to find them practically completed, so that we may advertise for bids in the fall, as arranged."

WALTER P. PHILLIPS, who is probably one of the best known old-time telegraphers today and who is now manager of the printing department of the Columbia Phonograph Company at Bridgeport, Conn., has written a stirring appeal to the chivalrous spirit of those engaged in the telegraphic, journalistic and related fields of activity concerning Robert W. Martin, an old-time telegraph man and a familiar with many of those who had an active part in the upbuilding of the industry in the early days, who has been ill and unable to help himself for some time. Mr. Martin was with Mr. Phillips in the service of the United Press (No. 1) and is one of the surviving members of the United States Military Telegraph Corps. Communications addressed to the care of the *Telegraph Age*, New York, N. Y., will be forwarded to Mr. Martin.

EDWARD G. DEWALD, heretofore manager of the water-wheel department of the Platt Iron Works Company, Dayton, Ohio, has become identified with the hydraulic turbine department of the Allis-Chalmers Company, as special representative for the Pacific Coast, with headquarters at 599 Mission Street, San Francisco. Mr. Dewald has been with the Platt company for the past twenty years, during five of which he served as manager of its San Francisco office; and he has been identified with many of the largest hydraulic power installations in the country, including the majority of those on the coast. Mr. Dewald's prominence in this field, coupled with the important position the Allis-Chalmers Company has taken in this field in recent years, makes his new connection noteworthy.

DANIEL E. MANSON, who has resigned as manager of the Boston office of the Westinghouse Electric and Manufacturing Company, to engage in engineering work with a corporation of which he will be vice-president and manager, was tendered a farewell dinner in Boston, July 13, by the officers and associates of the Westinghouse Company. During Mr. Manson's twelve years with the Westinghouse forces he has rendered services of a high order that merited his promotion through various positions, to the head of the Boston office, a post he has held for a number of years. The severance of Mr. Manson's relation with the company is viewed with genuine regret by its officers and the many friends he has made, but for his new work all unite in good wishes, a sentiment which the farewell dinner fittingly expressed. George E. Bates, of the Boston office, will succeed Mr. Manson as head of the Westinghouse sales force for the New England district.

EDWARD FOLGER PECK, general manager of the Schenectady (N. Y.) electric-railway system, was elected president of the New York State Street Railway Association at the annual convention of that body at Bluff Point, N. Y., on June 29 and 30 last. Mr. Peck in 1880 became connected with the American Electrical Company, of New Britain, Conn., which company subsequently became the Thomson-Houston Company. He was in charge of the exhibit of this company at the Philadelphia Exhibition in 1884, and was afterward in charge of the Thomson-Houston exhibit at the New Orleans World's Fair in 1884-1885. In 1885 he became general manager of the Citizens' Electric Illuminating Company, Brooklyn, N. Y., where he remained until 1897, in which year he organized the Peck Electrical Company, which did an engineering and supply business in New York city. He was appointed general manager, in 1899, of the Kings County Electric Light and Power Company, of Brooklyn, from which position he resigned in 1902 to become general manager of the Schenectady Railway. Mr. Peck is also president of the Electric Express Company, of Schenectady, N. Y. He is a member of the American Institute of Electrical Engineers and also of the Engineers' Club, of New York. He is well known in the electrical industry and is very popular both among his associates and in the profession at large.



OBITUARY.

ELWYN G. HOVEY, forty-two years old, died on July 9 at his home in Montclair, N. J., of pneumonia. Mr. Hovey was an electrical engineer for the Weston Electrical Instrument Company, having been connected with the company for over twenty years. He leaves a widow and three sons.

GEORGE FREDERICK DEACON, a well-known English engineer, died suddenly at his offices in London on June 17 last. Mr. Deacon was an assistant to Lord Kelvin on the SS. Great Eastern during the laying of the Atlantic cable in 1865. Since that time he became famous as the engineer in charge of the great Vyrnwy waterworks construction for the city of Liverpool

in 1877. He was the recipient of the Telford, Watt, and George Stevenson medals of the Institution of Civil Engineers. Mr. Deacon was a member of the council of the Institution of Civil Engineers, and president of the engineering section of the British Association in 1897.

ROBERT CLARK died at his home in Chicago, the first of this week, at the advanced age of eighty years. Mr. Clark came to Chicago in June, 1849, and was one of the pioneers of Chicago and Cook County. Up to fifteen years ago, when he retired from active business, he was head of the Ætna Iron Company, of Chicago. Mr. Clark was active in political life in the city of Chicago and held many important offices. He leaves one daughter, Mrs. Edwin D. Welch.

SIMON NEWCOMB, astronomer, mathematician and retired rear admiral of the United States Navy, died at the age of seventy-four at his home in Washington, D. C., on Sunday, July 11 last, and was buried last Wednesday with military honors in Arlington Cemetery. The body laid in state on Monday and Tuesday. The distinguished astronomer is survived by his widow, a daughter of the late Dr. Charles A. Hassler of the United States Navy, and three daughters—Dr. Anita Newcomb McGee, of Washington; Mrs. Francis Wilson and Mrs. Edward Whitney, both of New York. Simon Newcomb was born in Wallace, Nova Scotia, March 12, 1835. He received his early education from his father, John Burton Newcomb, and emigrated to the United States in 1853. He taught school for two years in Maryland, and afterward secured an appointment as computer of the United States nautical almanac, then published in Cambridge. While in Cambridge he undertook some of the most advanced astronomical work ever attempted in this country up to that time, his great work which brought his immediate international recognition being a mathematical theory on the orbits of the asteroids. In 1861 he was appointed professor of mathematics at the United States Naval Academy; later he was also assigned to duty at the United States Naval Observatory, in the course of which he negotiated the contract for, and supervised the construction of, the great twenty-six-inch equatorial telescope at that institution. He was secretary of the United States Transit-of-Venus Commission, 1871-1874, and observed the transit of Venus at the Cape of Good Hope in 1882. He was made director of the Nautical Almanac office in 1877, retiring at the age of sixty-two in 1897. He was professor of mathematics and astronomy at Johns Hopkins University, 1884-1894, and was also editor of the American Journal of Mathematics. Simon Newcomb received an enormous number of honors and distinctions. He was made a graduate of American, British and continental universities, receiving in all no less than nineteen degrees, of which only two were below the rank of doctor. He has received medals and prizes from the Royal Astronomical Society, the Dutch Society of Sciences, the Royal Society of London, the Astronomical Society of the Pacific, etc. He was an honorary or corresponding member of almost every important European scientific society in his line of work, besides his activity in similar lines in his own country. In 1874 he was made correspondent, and in 1893 one of the eight foreign associates, of the Institute of France, being the first native American since Benjamin Franklin to be so honored. He was made officer of the Legion of Honor of France in 1893, and commander in 1907; Knight of the Prussian Order of Merit for Science and Art, in 1906 (receiving special authority from Congress to accept these honors). Professor Newcomb was a prolific writer and besides a list of over three hundred papers on his researches he has written textbooks on astronomy, mathematics and economics, besides magazine articles, etc. He published tables of the motion of the stars, the planets and the moon, now used by astronomers in their computations and as the basis of present-day navigation. By the death of Professor Newcomb the United States has lost one of her foremost scientists of the century, and one whom it will not be easy to replace.

LEGAL NOTES.

PROPRIETY AND LOGIC OF "READINESS TO SERVE" CHARGE—In an opinion rendered on June 14, 1909, in the case of the Little Rock Railway and Electric Company vs. Newman, the Supreme Court of Arkansas decided that the company was not violating an act of the General Assembly, in stipulating a "readiness to serve" charge in making a contract with the plaintiff, prior to connecting his residence with the lighting plant. An analysis of the act did not reveal any attempt to regulate charges further than to require uniformity and publicity, nor to compel the company to hold itself in readiness to supply electricity to those who use none, and it does not specify that a minimum charge is forbidden. The court ruled that a readiness to serve charge amounts to the same as a minimum rate charge, which does not violate the act.

LIABILITY IN TELEPHONE BOOTHS THAT CANNOT BE OPENED FROM INSIDE—Under the rule that an employer is not an insurer, but is required to use ordinary care to make his premises reasonably safe for the use of his employes, the Court of Appeals of Kentucky holds, in Georgetown Water, Gas, Electric and Power Company vs. Forwood, 113 Southwestern Reporter, 112, that a telephone booth should not be so constructed that it cannot be opened from the inside. It holds that if an employe was locked up in such a booth he had a right to try to get out; he had a right to use reasonable effort to get out of the box, exercising such care as might be reasonably expected of an ordinarily prudent person. If he used ordinary care, and was injured in his effort to escape, his employer would be liable for any injury resulting from its negligence.

LIABILITY FOR INJURY OF TRIMMER FROM BREAKING OF DEFECTIVE PIN—A trimmer of electric lamps was injured by the giving way of one of the pins in the cross-arms on which the wires were strung. The supreme judicial court of Massachusetts says, Jennison vs. Waltham Gaslight Company, that he was required to climb the pole, and upon reaching the last iron step being obliged to go higher to reach the lamp, the jury could find, on his evidence, that not only the feasible and customary way was to grasp one of the pins to assist him in making the ascent, but in so doing he was following the instructions given him by the company. If the company knew that he must perform his work in that way, then by neglecting to provide a properly adjusted pin, or to see that as inserted it remained sound, it failed at common law, as well as under the Massachusetts statute, to discharge its duty to the trimmer.

VALIDITY OF RULES AND REQUIREMENTS OF RURAL TELEPHONE COMPANIES—In the case of Buffalo County Telephone Company vs. Turner, 118 Northwestern Reporter, 1064, the Supreme Court of Nebraska holds that a rule of a rural telephone company that telephone rent must be paid six months in advance is reasonable; and a subscriber, refusing to comply therewith, is not entitled to service from the company. Nor will the existence of a counterclaim or set-off asserted by the subscriber, a large part of which is exorbitant and illegal, justify him in demanding that he be given service without prepayment of charges as other subscribers pay. A telephone subscriber is presumed to know that his telephone is liable to get out of order, and, if it is situated in the country, that some time may elapse before it can be repaired, and such subscriber is only entitled to a deduction from his bill subsequent to the expiration of a reasonable time after the company had notice of the trouble and failed to repair it.

CONTRACTS FOR A CERTAIN NUMBER OF LIGHTS IN SIGNS MUST BE LITERALLY MET—To an action brought to recover the contract price of a specially-built electric sign one of the defenses was that the sign was to have a border consisting of rows of electric lights, containing 296 lamps so arranged that by a system of intermittent lights the border produced the effect of two snakes chasing each other, whereas a less number of bulbs were used. To permit the jury to find that the plaintiff might recover upon the theory of substantial compliance with his contract, the Court of Civil Appeals of Texas holds, on appeal of Ellison Furniture and Carpet Company vs. Langever, 113 Southwestern Reporter, 178, was in error. It says that if the parties to the contract specifically stipulated that the border should contain 296 lights, the courts would have no power to set aside such stipulation; but the plaintiff would be bound by it, even though a less number of lights might be more desirable, either from the standpoint of beauty or utility.

EXTENT OF SERVICE REQUIRED OF TELEPHONE EXCHANGES—That telephone exchanges are impressed with a public use as common carriers of news, the Supreme Court of Indiana says, in the case of State vs. Cadwallader, is settled in that state. That they must furnish impartial service without discrimination to all persons in the same or similar classes is, the court believes, everywhere the rule. There is, however, as the court conceives, a marked difference between furnishing initial, independent service, through or by means of an independent exchange, and secondary service by an interchange of business, or by means of connecting two or more plants, so that for all practical purposes of the users they constitute but one system, for that in effect, in the absence of contract, would amount to practical confiscation of private property. Patrons of the corporation or individual contracted with are bound to know that, in the absence of an undertaking so to do, another corporation or individual is not bound to subject its or his property to their use by direct or unrestricted use of their lines.

TELEPHONE CONVERSATIONS OVERHEARD AT THIRD INSTRUMENT—Where a witness offered in a case gained his information by listening to a conversation by the use of another telephone at the defendants' place of business, the Supreme Court of New York, appellate term, says, Rimes vs. Carpenter, 114 New York Supplement, 96, that unquestionably a conversation overheard between parties whose voices are recognized by the witness may be proven, and there is no ground for distinction, in principle, between such a case and that of a conversation by telephone, which the witness overhears, where the actual connection between the instruments is shown in such wise as to identify the very conversation, and the persons holding the conversation are known. From the proceedings upon the trial it appeared that the defendants could probably have shown that

three instruments on the same wire, being those used by the principals in the conversation and by the person who overheard it, would serve as a medium of transmission, whereby what was heard by one listener must have been heard by the other and have been the actual words of the speaker. In this situation the conversation overheard by a witness would clearly be the proper subject of his testimony, where the conversation itself, as between the parties, was competent and relevant to the issues.

CONTRACT FOR TELEPHONE SERVICE AT GREATER THAN PRESCRIBED RATES UPHELD—As it has been held that a telephone company may, by entering into a voluntary agreement with the city fixing maximum rates, be estopped from questioning the authority of the city to enter into such agreement, so the Supreme Court of New York, special term, Erie County, holds that a citizen may, by entering into a contract with the telephone company, be estopped from questioning the authority of the company to make such a contract with him.

ELECTRICAL SECURITIES.

It was expected that following the short holiday week there would be an opening up both as to activity and prices in the stock market. While the negotiations on the first sessions were encouraging, the market slipped back into the rut, and, although news of an adverse character was lacking, there has been very little animation.

Electric Bond and Share Company; the regular quarterly dividend of one-and-one-fourth per cent on the preferred stock, payable August 1; books closed July 16 and reopen August 2.

Manhattan Electrical Supply Company; the regular semi-annual dividends of three per cent on the preferred and three per cent on the common stock, both payable August 2 to stock of record July 10. Books closed July 10 and reopen August 3.

Milwaukee Electric Railway and Light Company; the regular quarterly dividend of one-and-one-half per cent on the preferred stock, payable July 31 to stock of record July 20.

National Carbon Company; the regular quarterly dividend of one per cent on the common stock, payable July 15.

New Hampshire Electric Railways; regular semi-annual dividend of one per cent on preferred stock, payable July 31 to stock of record July 20. Books close July 20; reopen August 2.

New York and Queens Electric Light and Power Company; the regular semi-annual dividend of two-and-one-half per cent on the preferred stock, payable August 10 to stock of record July 31.

J. G. White & Company; the regular quarterly dividend of one-and-one-half per cent on the preferred stock, payable August 1 to stock of record July 24.

NEW YORK.

	July 12.	July 5.
Allis-Chalmers common	15	15⅛
Allis-Chalmers preferred	51⅝	51¾
Amalgamated Copper	81¼	82⅝
American Tel. & Cable	80*	80*
American Tel. & Tel.	140½	140¾
Brooklyn Rapid Transit	78	79½
General Electric	163½	164
Interborough-Metropolitan common	11	16½
Interborough-Metropolitan preferred	30⅛	49⅜
Kings County Electric	130	130
Mackay Companies (Postal Telegraph and Cables) common	..	79½
Mackay Companies (Postal Telegraph and Cables) preferred	..	73½
Manhattan Elevated	145	143
Metropolitan Street Railway	20	20
New York & New Jersey Telephone	125	124
U. S. Steel common	68⅞	69⅛
U. S. Steel preferred	125⅜	125⅛
Western Union	71¾	72
Westinghouse common	84	84
Westinghouse preferred	121	..

*Last price quoted.

BOSTON.

	July 12.	July 5.
American Tel. & Tel.	140½	140¾
Edison Elec. Illuminating	248	250
General Electric	163½	164
Massachusetts Electric common	13¾	13¼
Massachusetts Electric preferred	71½	71
New England Telephone	134	134½
Western Tel. & Tel. common	10	9¾
Western Tel. & Tel. preferred	37	37

PHILADELPHIA.

	July 12.	July 5.
American Railways	44¾	45¼
Electric Company of America	12⅝	12½
Electric Storage Battery common	52	52
Electric Storage Battery preferred	52	52
Philadelphia Electric	11¾	11¾
Philadelphia Rapid Transit	28¾	28⅝
Philadelphia Traction	91	90¾
Union Traction	53	53

CHICAGO.

	July 12.	July 5.
Chicago Railways, Series 1	112	112¾
Chicago Railways, Series 2	41	40½
Chicago Subway	21	22
Chicago Telephone	132	132
Commonwealth Edison	120½	120
Metropolitan Elevated common	15	15½
Metropolitan Elevated preferred	47	49
National Carbon common	91	91
National Carbon preferred	115	117½

INDUSTRIAL ITEMS.

PASS AND SEYMOUR, SOLVAY, N. Y., manufacturers of electrical specialties, are distributing a catalogue showing a few of their porcelain receptacles.

THE NEW YORK INSULATED WIRE COMPANY, NEW YORK CITY, is distributing a useful innovation in the form of advertising blotters. On one of these is a calendar for the current month.

THE PNEUMELECTRIC MACHINE COMPANY, Syracuse, N. Y., is now equipping its coal puncher with an alternating-current motor of two or three-phase for any voltage or frequency. The complete machine weighs only about eight hundred pounds.

THE SAFETY ELECTRIC COMPANY, of Chicago, is meeting with considerable success in putting out a two-candlepower refilled sign lamp. These lamps are made for any voltage from 100 to 130. A circular, entitled "S. S. 14 Sign Globe," describes these lamps and can be had upon request.

THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, Cleveland, O., has issued a very attractive and instructive booklet containing a series of five articles on electric-motor control, written by the president of the company, A. C. Eastwood, copies of which may be had on request.

THE AMERICAN SEWER PIPE COMPANY, Pittsburg, Pa., has received, through A. L. Waterbury, manager of its Chicago office, an order from the Commonwealth Edison Company, of Chicago, for 1,000,000 duct feet of vitrified clay conduit. Shipments on this order have already begun, and will continue for three months before the order is filled.

THE HOYT ELECTRICAL INSTRUMENT COMPANY, Penacook, N. H., publishes a monthly bulletin containing some very interesting information concerning the Hoyt electrical instruments, and in addition to this sufficient material in a lighter vein to render a perusal worth while. Copies of this bulletin will be furnished to those interested upon request.

THE KIMBLE ELECTRIC COMPANY, Chicago, Ill., has found it necessary to enlarge its facilities for handling its business, owing to the increased demand for the Kimble variable-speed, single-phase, alternating-current motors. James K. Bass, who recently came from New York to fill the office of treasurer and manager of the above company, is an old Chicagoan and has a large acquaintance in the electrical field. It is the purpose of the company to improve its product wherever possible.

THE NEW YORK INSULATED WIRE COMPANY, of New York, in order to take care of the increased local demand for their rubber-covered wire and insulating tapes, have been obliged to secure a new and larger New York stock-room. The new location, 80 Murray Street, is an admirable one, being right in the midst of the largest New York jobbing and supply houses, and the increased stock which they are now carrying enables them to fill more promptly than ever orders from their out-of-town and local friends.

THE CARLYLE JOHNSON MACHINE COMPANY, Manchester, Conn., announces in a folder containing a halftone of the new factory, that increased business has compelled it to seek larger and better quarters. The new plant is located at Manchester, Conn., nine miles east of Hartford, on the Willimantic Division of the New York, New Haven & Hartford Railroad, where the facilities of the company will be much improved so as to permit of an even better and prompter attention to orders than in the past.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., manufacturing the well-known Exide Battery, Chloride Accumulator and Tudor Accumulator, has issued an instructive and timely booklet, entitled "The Exide Battery," which will be welcomed by all interested in the storage battery. An introduction gives a brief history of the commercial development of the storage battery, and this is followed by a clear and concise account of the design, manufacture and care of the Exide Battery, with illustrations and many practical hints.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, Ohio, has prepared a very useful chart giving in compact form directions and formulas for testing polyphase induction motors. The tests referred to are: Determination of primary resistance, no-load test, short-circuit test, determination of motor characteristics, service test, resistance and puncture tests of insulation, and heat tests. The chart, which is eight by ten-and-one-half inches, is made for mounting in a convenient manner so that its information is readily ascertainable.

THE ELECTRICAL ALLOY COMPANY, Morristown, N. J., draws attention in a recent leaflet to its special electrical resistance wires sold under the specific guarantee that they have been submitted to the most exhaustive tests of the Electrical Testing Laboratories of New York city. The best-known products and those which are in the greatest demand are the ideal wire, for use in making electrical instruments, shunts, resistance standards, rheostats, etc., Phenix wire, with the highest specific

resistance of any wire on the market, for use in the manufacture of electrically heated appliances, and German silver wire, with any percentage of nickel required. A new catalogue with revised prices is being distributed and samples and the fullest particulars will be sent on request.

THE GARWOOD ELECTRIC COMPANY, Garwood, N. J., announces that it has appointed the International Supply and Export Company, Bank of Commerce Building, St. Louis, Mo., as its sales agent. The International Supply and Export Company is a well-known manufacturers' agent in the Middle West, and keeps a number of salesmen on the road.

THE I. P. FRINK COMPANY, 551 Pearl Street, New York, N. Y., installed its system of special reflectors for lighting the squash court of the University Club, Chicago, a few months ago. These proved so satisfactory that the company has just finished putting in these reflectors for illuminating the tennis courts also. Bronze reflectors for lighting the desks and screens have been placed in the National Bank of Commerce, St. Louis, Mo., and the fixtures for illuminating the art gallery of the Alaska-Yukon Pacific Exposition were made by this company.

THE ROCKINGHAM POWER COMPANY, Rockingham, N. C., has been experimenting with a new device called the "reflectorlier," the invention of William H. Browne, who is president, general manager and one of the receivers of the company. This appliance combines in a new method, fixtures, reflecting surfaces and lamps in such a way as to produce without shadows the most widespread and uniform distribution of the light. The results of the experiments were decidedly encouraging, and we expect to hear more of this new device, for which letters patent have been applied.

THE CROUSE-HINDS COMPANY, Syracuse, N. Y., has issued No. 106 of its "Condulet Talks," which are published weekly. Type "Q K L" is described as strong and waterproof, protecting the outside switch and wiring from the weather and the water from window washing. It is proof against tampering by unauthorized persons, and is for the man with a key. An illustration of a drug-store window is given, the advantage of having a suitable switch conveniently located in an inconspicuous place outside the building being clearly demonstrated. Condulets are sold by the Western Electric Company of Chicago.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a new circular and price list descriptive of electric-light supplies. This list embodies some thirty pages and should be of general interest to the electrical fraternity. The company is also sending out a new bulletin descriptive of high-voltage transformers for use in serving consumers directly from high-tension lines. A considerable amount of data is given as to construction of these transformers and attention is particularly called to the special bushings which are claimed to give an insulation strength much greater than has heretofore been secured.

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., has published a booklet, entitled "How to Save Coal," discussing this from the point of view of recovering waste heat in the chimney flue gases. The booklet further describes the construction of the Green economizer, illustrating the new extended top header, the new bottom header specially designed to avoid choking from soot, the new sectional covering and other improved features. There are several illustrations of large plants, such as the Delaware, Lackawanna & Western terminal power plant, which have recently been equipped with Green economizers and Green mechanical draft fans.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has prepared an attractive little booklet, "Electric Power for Domestic Purposes," which offers many valuable suggestions for the use of small motors in the home. Among the labor-saving applications of electric power noted are the sewing machine, vacuum cleaner, washing machine, ice-cream freezer, coffee grinder, meat chopper, ironing machine, silver polisher, dish washer, and the motor-driven pump. A novel electric-driven household utility illustrated in the folder, is the combination of a coffee grinder and meat chopper compactly attached to a small motor. The booklet will be sent upon request to the Pittsburg office of the company.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., announces that it has purchased the plant, business and patents of the J. L. Schureman Company, of Chicago. The manufacture of the well-known types of Schureman controlling apparatus will be continued and all agreements and contracts made by the J. L. Schureman Company will be faithfully carried out by its successor. The services of S. M. McFedries, general manager of the Schureman Company, have been retained by the Cutler-Hammer Manufacturing Company and he will remain in active charge of the manufacture and sale of Schureman apparatus. J. L. Schureman retires from the business. Until further notice customers of the Schureman company should direct orders and inquiries to the old address, J. L. Schureman Company, 70 West Jackson Boulevard, Chicago. Communications addressed to any of the offices of the Cutler-Hammer Manufacturing Company will also receive prompt and careful attention.

THE JARVIS ENGINE AND MACHINE WORKS, Lansing, Mich., manufacturers of "Jarvis" safety water columns, contractors' hoists, automatic switches, power pumps, "Monitor" feed-water purifiers, oil extractors, etc., also make a specialty of motor-driven pumps, some of which are described in Bulletin 101, which is now ready for distribution. The type E pump, operated by a one-eighth-horsepower alternating-current motor, has a capacity of seventy gallons per hour, working pressure seventy-five pounds, speed 100 strokes a minute. Type K pump, operated by a one-half-horsepower motor, or other desirable power, has a capacity of 300 gallons per hour, and is suitable for any working pressure up to 250 pounds, with proper power.

THE NATIONAL ELECTRIC LAMP ASSOCIATION, in bulletin No. 6E, issued by the engineering department, treats of tungsten sign lamps. A general description is given by way of introduction, followed by particulars as to frosting, cost of operation, uses, quality of light equipment and operation, alternating-current system, flashers and typical installation. Useful tables and instructions as to ordering complete a very handsome pamphlet. It may be noted that everything put out by this association is always most thoroughly and clearly arranged. This bulletin covering as it does the performance, economy, equipment and general uses of the Tungsten sign lamp should be carefully perused by everyone interested in the latest development of electric lighting.

B. S. BARNARD AND COMPANY, New York city, manufacturers of clay material and in particular vitrified, salt-glazed electrical clay conduit for underground installation, draws attention in a four-page circular to various of its products, such as single butt joints, two, four, six and nine-inch multiples of various sizes; also to the "Lyle" mandrel, and metal wrappers and plugs. The last are described as being made for both permanent and temporary use. The permanent one is of perforated metal and when applied with a covering of cement it forms a complete air and water tight stopper at the end of the duct. The temporary plug is made with a rubber gasket perfectly air and water tight, and can be inserted or drawn with little effort. Prices are furnished on request.

DATES AHEAD.

Ohio Electric Light Association. Annual convention, Toledo, July 13-15.

National Electrical Contractors' Association. Annual convention, Toledo, Ohio, July 21-23.

Maine Electric Association. Annual convention, Portland, Me., July 29-30.

Society of Automobile Engineers. Annual convention, Chicago, August 5-7.

Michigan Electric Association. Annual convention, Detroit, Mich., August 17-19.

International Association of Municipal Electricians. Convention, Atlantic City, N. J., September 14-16.

American Street and Interurban Railway Association. Annual convention, Denver, Colo., October 4-9.

Pennsylvania Electric Association. Annual convention, Eagles Mere, Pa., September 8, 9 and 10.

Northwest Electric Light Association. Annual convention and joint session with Seattle branch, A. I. E. E., Seattle, September 7, 8 and 9.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired July 12, 1909:

478,565. DESK ATTACHMENT FOR TELEPHONES. Lewis C. Butler, West Bay City, Mich.

478,664. ELECTRODE. Armand Vanden-Kerckhove, Brussels, Belgium.

478,692. TELEPHONE. Paul M. D'Unger, Chicago, Ill.

478,722. DISTRIBUTION OF ELECTRIC CURRENTS. Elihu Thomson, Swampscott, Mass.

478,743. TELEPHONE-REPEATER. Thomas A. Edison, Menlo Park, N. J.

478,788. ELECTRICAL THERMOSTAT. William L. Denio, Rochester, N. Y.

478,789. ELECTRIC SIGNALING APPARATUS. William L. Denio, Rochester, N. Y.

478,816. ELECTRO-MECHANICAL APPARATUS FOR STARTING OR REVERSING MACHINERY. Albert Piat, Paris, France.

478,821. ELECTRIC ELEVATOR. Alonzo B. See and Walter L. Tyler, Brooklyn, N. Y.

478,865. ELECTRIC TIME-ALARM. John Jacobi, Brooklyn, N. Y.

478,956. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS. William H. Ford, St. Louis, Mo.

478,968. ELECTRIC MOTOR. Harlon F. Ong, Newberg, Ore.